# ELECTRICAL REVIEW

THE PIONEER ELECTRICAL WEEKLY OF AMERICA

VOL. LI. No. 1. NEW YORK, SATURDAY, JULY 6, 1907. ISSUED WEEKLY



CHARLES W. PRICE . . . . . PRESIDENT, TREASURER AND EDITOR
13 Park Row, New York City.

STEPHEN H. GODDARD . . . . . SECRETARY AND MANAGER
13 Park Row, New York City.

WILLIAM HAND BROWNE, JR. . . . . TECHNICAL EDITOR

ALYSLIE A. GRAY . . . . . MANAGING EDITOR

NEW YORK
PUBLISHING OFFICE . . . . . 13-21 PARK ROW

CHICAGO
WESTERN OFFICE . . . . . MANHATTAN BUILDING

BOSTON
NEW ENGLAND OFFICE . . . . . 95 MILK STREET

LONDON
EUROPEAN OFFICE, HENRY W. HALL, Manager, 42 OLD BROAD STREET, E. C.

TELEPHONE AND CABLE

TELEPHONE "21 Cortlandt." Private exchange to all Departments.
REGISTERED CABLE ADDRESS: "Electview," New York.

SUBSCRIPTIONS

One Year, United States . . . . . $3.00
One Year, Canada . . . . . 4.00
One Year, Foreign Countries . . . . . 6.00
Single Copy, 10 cents. Back numbers, beyond one month, each . . .25

ADVERTISING

CHANGES for advertisements should be in this office by *Friday noon* for the following week's issue.

NEW ADVERTISEMENTS should be in the office not later than *Monday noon* to assure publication in that week's issue.



Entered at the Post Office at New York as second-class matter under the Act of March 3, 1879.


CONTENTS


EDITORIAL:
- The Efficiency of the Telephone Receiver . . . 1
- The Institute Convention . . . 2
- The Economy of Electric Pumping . . . 3
- Progress in Wireless Telegraphy . . . 3

Twenty-fifth Annual Convention of the Street Railway Association of the State of New York . . . 4
The Technical Instruction of Practical Men . . . 6
The Street Railway Convention . . . 6
The Huronian Company's Power Development . . . 7
The History of Mathematics . . . 15
The Use of Wooden Poles for Overhead Transmission, by C. Wade . . . 15
The Annual Meeting of the National Electrical Trades Association . . . 17
The Technical Publicity Association . . . 17
Convention of the American Institute of Electrical Engineers . . . 18
Electrical Notes from Europe . . . 24
Coal Handling in Small Plants, by H. F. Knowlton . . . 25
REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE . . . 26
Illinois Contractors' Annual Meeting . . . 27
INDUSTRIAL SECTION:
- Automatic Storage Battery Charging Switch . . . 28
- Heavy-Duty Field Rheostat . . . 28
- Electric Fountains for Decorative Work . . . 28
- Autogenous Welding . . . 29
- The Fox Terminal Hood . . . 30
- The Sky-Rocket Lightning Arrester . . . 30
- Good Year for Car Building . . . 30

CURRENT ELECTRICAL NEWS . . . 31
RECORD OF ELECTRICAL PATENTS . . . 37



Copyright, 1907, by Electrical Review Publishing Co.


## THE EFFICIENCY OF THE TELEPHONE RECEIVER.

The telephone receiver, as is well-known, is a marvel of sensibility, and is frequently employed for detecting effects not easily observable by other means. In fact, it has only recently been said that in the problems of radio-telegraphy and telephony the receiving end may be considered to have been satisfactorily solved; therefore it is the transmitting end upon which more active attention should be concentrated. We are now able to detect, due to the telephone and a proper responder, energy disturbances exceedingly minute, as compared with those set up by the apparatus which first produces the disturbance; therefore we should try to transform a greater portion of this original electrical oscillation into electrical waves radiating from the antenna. We may, however, be required to modify this plan of attack, because, although the sensitiveness of the telephone receiver is not questioned, its acoustic efficiency has been overlooked, and if it be possible to improve the receiver in this respect, it is not improbable that this would result in improved communication and greatly increased distances. In other words, the instrument might be made more sensitive.

This idea is suggested by a recent communication to *Comptes Rendus* (Paris). In this the acoustic efficiency of the telephone receiver is discussed by Mr. H. Abraham. The author defines the acoustic efficiency of a receiver as the ratio between the power actually given out by it in sound waves to the electrical power utilized in setting the diaphragm in motion. The latter quantity is easily measurable. To determine the first, an expression is deduced by seeking a figure for the maximum power available for a given pitch of sound produced by the diaphragm. An application of this deduction in an experiment led to the conclusion that the electrical power spent in the receiver was about 700 centimetre-gramme-second units, while that given out by the diaphragm was only one unit. This, however, represents maximum conditions. Actually, it is concluded that the ratio will be about 1,000 to one; that is, the acoustic efficiency of the receiver is one-tenth per cent. It has been the custom to hold up the incandescent lamp as an example of inefficient apparatus, but according to these figures, the efficiency of the telephone receiver is much more disgraceful. The telephone engineer should look into this matter, for although there are, no doubt, other features, much more important than the efficiency of a device which requires so little power to actuate it, an improvement in this respect would, no doubt, bring in others.

It should be noted that the problem attacked by Mr. Abraham is an exceedingly difficult one, and rough methods of

approximation were allowable. He has taken as the power delivered to the receiver merely that useless portion of it which is utilized in heating the electrical conductor. That portion which goes to supply hysteresis of the iron, and particularly that part which is actually concerned in moving the diaphragm, are neglected. Presumably these are negligible, and they would, of course, if considered, still further reduce the efficiency of the device.

## THE INSTITUTE CONVENTION.

The recent convention of the American Institute of Electrical Engineers, held at Niagara Falls, N. Y., June 25 to 28, was certainly profitable and enjoyable to those who attended. Niagara Falls is a most suitable place for such conventions, as it is not only a great electrical engineering centre, but it probably presents as many attractions to visitors as any other resort in the world.

Many thanks are due to the committees and officers who were in charge of the arrangements and conducted the work of the session. A full programme of excellent papers was prepared and carried out, yet so well did President Sheldon manage the meetings that at no time did the discussion drag, and although no paper was omitted except when the author was absent, usually adjournment was made not long after the scheduled time. On one occasion, it is true, the session was extended, but this was due to an important discussion on the proposed code of ethics, and more particularly by interest evinced by those present at this meeting in the topic of technical education.

Although it can not be stated that any epoch-making paper was read, a good number dealt with questions of great immediate importance. One of these was the question of frequency for alternating-current railway systems. Another, as already mentioned, was technical education. A third—and this is one which has been frequently before the Institute, and probably will continue to be discussed for many years—is that of lightning protection. Another important work, no doubt, was the adoption of the revised standardization rules. These rules were prepared and presented at the Milwaukee convention last summer, and were referred back to the committee for certain modifications. They were then approved by the board of directors and presented at Niagara Falls, not for discussion, but merely for formal action.

When the proposed code of ethics was presented, there was shown to be a considerable difference of opinion. This code was drawn up by a committee appointed in consequence of the presidential address delivered at the Milwaukee meeting by President S. S. Wheeler, who took for his topic "Engineering Honor." He pointed out that there are certain well-recognized customs prevailing among the professions, and these he brought to the attention of members of the Institute. A committee was then appointed to consider the advisability of preparing a code of ethics for the consideration of the Institute, and it was this report which was presented at the recent convention. In some ways this committee seems to have taken a rather broad view of the subject, yet in other ways the recommendations are too definite. In such a matter it is not practicable to draw up a set of rules which will meet all contingencies, just as one would prepare a sheet of instructions to govern the conduct of a switchboard attendant. What might be done, however, would be to define a few general principles. It hardly seems that such a code should include rules for determining if an engineer may accept a position or not, or that he should withdraw his services because he can not have everything his own way. It is also a little difficult to see just what standardization has to do with ethics. There seems to be a little confusion here, for while all will admit that the manufacturing industry is advanced by the adoption of standards, engineering progress must be brought about largely by departing from old standards and introducing new; in other words, by developing new methods and apparatus. Certain of these points were brought up at this meeting, but owing to a misunderstanding of the new constitution, which forbids action involving the policy of the Institute being taken at a convention, the action of approval which was then taken was, at the succeeding session, declared void. The code was therefore referred back to the committee for reconsideration and submission to the board of directors.

One point made was that the recognition of these principles would show the other professional bodies that the Institute was not a trade organization. In the opinion of many, a formal recognition of a definite code would have just the opposite effect, particularly if such definite rules are included in it. It was said at the time after the vote had been taken that this was the first time any such action had been taken by an engineering society. This fact itself argues for cautious procedure in such a matter. The engineer is a responsible person, and while he may recognize general principles as tending to elevate and dignify his profession, he can not submit to having his conduct governed by narrow and definite rules. It is the opinion of some that these rules were intended to be suggestive rather than binding, and to be modified at will to fit local conditions, provided, of course, the general policy be followed; but in this case it does not seem right either that they should be laid out so definitely, or that in this form they should be given the formal sanction of the Institute.

It must be most encouraging to the hard-working, underpaid teacher to see so much interest shown by the profession at large in his work. Good can not fail to come from such exchanges of opinion, and the teacher should gladly listen to the ideas of his practising brother. Yet he must remember that he himself knows more about the difficulties of laying out a satisfactory curriculum and of giving the young man a satisfactory training, at the same time keeping up his interest, than a practising engineer can. In the end he must therefore depend more on his own experience than upon the suggestions of those who have never taught. At this meeting of the Institute, following the discussion upon technical education, a motion was carried to appoint an Institute committee on education. It seems as though there is rather too much tendency to-day in the Institute to appoint special committees on any and every topic of particular interest which comes up. It may now be asked, what will be

the functions of this committee? Are they merely to secure papers and discussions on educational topics? If so, this is a matter that properly belong to the papers committee. On the other hand, is it intended to draw up a curriculum for submission to the various technical institutions? This can hardly be in mind, for it is most improbable that any, or at most, many, institutions would be willing to accept a course of study prepared in this way. Too much depends upon the ideas and facilities of each school. The Institute is a large and growing body, with wide interests; yet it is possible to attempt too much and to waste effort on problems that might, for a while at least, be profitably left to those who are most competent and best fitted to solve them.

The Niagara convention, under the new order of things, closes the year of one administration and introduces that of the succeeding one. During President Sheldon's year the Institute has grown in a substantial way, and has moved into its new quarters in the Engineering Societies Building, thus practically beginning a new era. During the year to come the reins will be in the competent hands of Mr. Henry Gordon Stott, and the members may look forward with confidence, for the Institute will surely move forward to an even better and stronger position than that which it occupies to-day.

## THE ECONOMY OF ELECTRIC PUMPING.

The establishment of electric pumping plants in connection with municipal water and sewerage systems is becoming such a general practice that in many quarters the use of steam power for this class of work is considered only as a tentative solution of the problem, and even the proposition of installing a gas engine plant sometimes fails to make a good showing when compared with the guaranteed performance of the electric motor.

Of course, to handle this class of business, a central station must be prepared to quote an extremely low rate per kilowatt-hour, and to do the work profitably the municipal installation must be kept off the peak of the load; with a properly designed system of reservoirs or sewers it is fortunately possible in most cases where a very low rate applies to confine the operation of the electrically driven plant to the hours of light or moderate load. The situation is very different from that of the factory which requires power up to 5 or 6 P. M., and which can not afford to stop work before the peak comes on at any season of the year when generating capacity is heavily taxed.

With coal costing from $3.50 to $4 a ton delivered at the plant, the rate per kilowatt-hour to balance the expense of operation by steam was determined by a recent case in practice to be from two to 2.3 cents. The steam plant needed for the work cost, however, about three times as much as the electrical installation, and the floor space of the latter was but twenty per cent of that required by the boiler and engine station. To meet gas engine competition with gas at seventy-five cents a thousand feet, an electric power rate of about 1.8 cents per kilowatt-hour was required, but the cost of installing the gas plant would have been double that of the electric, and the floor space certainly three times as much. The electric plant possessed the further advantages of being operated with a minimum amount of labor; it promised a cleaner, quieter and more flexible installation, and it was therefore installed promptly after the merits of the different motive powers had been weighed.

## PROGRESS IN WIRELESS TELEGRAPHY.

At the discourse delivered before the Royal Institution, of Great Britain, in the latter part of May, Dr. J. A. Fleming discussed recent contributions to electric-wave telegraphy. In this he described the work which has been done of late, both along old lines and in some newer directions, notably in the field of directive radiation. Here the experiments made by Marconi, Braun and himself were explained, and his ideas of the effects produced. Although this side of the work has not advanced far, some useful results have been secured, particularly those which enable a receiving station to determine, more or less definitely, the direction from which the signals being received are coming.

One phase of this work to which attention was called is the necessity of making a thorough study of the causes which vary the transparency of space to long electric waves. This effect was first noticed by Marconi, and later Fessenden described his own observations. The transparency of the terrestrial atmosphere seems to vary from day to day and from hour to hour. It is better at night than in the daytime. There also seems to be another effect, differing possibly from the other, which is most noticeable near the transmitting antenna. This damping action fluctuates from hour to hour and from month to month, according to laws not yet determined, and too little is known to enable any generalization to be made concerning it.

It would seem that this large field offers great opportunities for the young investigator to exercise his ingenuity and energy to some purpose. The problem of wireless communication can not be said to have been satisfactorily solved until more is known about the way in which the message is transmitted and about the interfering influences. When the art of telegraphy was invented, the problem of transmission had to be solved. The same situation confronted the telephone, and until the laws governing the transmission of telephonic currents were fairly well understood, the art could not go forward. What is now needed for advancing wireless telegraphy, and what will do more in this direction than the invention of new receiving devices and new methods of setting up electrical waves, is a painstaking and thorough study of the atmospheric conditions which affect the radiation of these waves. The field is, of course, large and difficult to explore, but that is all the more reason why well-directed efforts should be made in it. At first thought it seems as though the work must be done on a working scale out of doors, yet it may not be impossible to devise some laboratory method of studying these actions which will enable the effects of various influences to be simulated and varied at will. It has been found in other arts that the conditions can be studied much better in a laboratory on a small scale. Even though not all of the effects can be introduced, some of them, at least, might be studied, and thus a better position gained for understanding the action of the others.

## TWENTY-FIFTH ANNUAL CONVENTION OF THE STREET RAILWAY ASSOCIATION OF THE STATE OF NEW YORK.

HOTEL CHAMPLAIN, LAKE CHAMPLAIN, N. Y., TUESDAY AND WEDNESDAY, JUNE 25 AND 26.

President J. N. Shannahan, of the Fonda, Johnstown & Gloversville Railroad Company, called the convention to order at 10.30 o'clock Tuesday morning, June 25. After calling the roll of members, the secretary read the minutes of the last annual meeting.

President Shannahan delivered his annual address and then introduced William L. Pattisson, secretary and counsel of the Plattsburgh Traction Company. On behalf of the Plattsburgh Traction Company, he extended to the members and the ladies in attendance the courtesy of the line.

The reports of the executive committee, the treasurer and the secretary were received.

Secretary J. H. Pardee reported that there were twenty-six member companies who are active members, a gain of three during the last year. Of associate members there were nine, and allied members sixty-eight.

The report of the committee on "Braking" was read and accepted, following which the paper entitled "Some Phases of Electric Railway Accounting," by J. C. Collins, secretary of the Rochester Railway Company, was read. The report of the committee on "Standard Rules" was called for, and Edgar S. Fassett, general manager of the United Traction Company, of Albany, N. Y., in reporting, said there was nothing new to add to the rules as last presented.

C. Loomis Allen, vice-president and general manager of the Utica & Mohawk Valley Railroad Company, called attention to the fact that while a majority of the city roads in the state were operating under a standard set of rules, it was probable that the interurban lines were operating under rules of their own.

After some discussion, upon motion of E. F. Peck, general manager of the Schenectady Railway Company, the present committee on standard rules was discharged, and upon motion of Mr. Allen the question of rules was left to two committees, of three each, to be appointed by the president, and consisting of a city committee and an interurban committee. The committee on interurban rules was requested to report at the first quarterly meeting.

Opening the discussion on Mr. Collins's paper, F. W. Wilson, general manager of the International Railway Company, said that in Buffalo a sheet is used on which the estimate is made; in one corner there is a place for the job number, in another a place for the approval of the manager and president. About four inches of the bottom is left for the records of the auditor of the amount of supplies and cost of labor, and that is posted from time to time. When the job is completed the company has a very complete tabulation of the total cost, both of labor and all kinds of material. This is worked out in price per foot of single track for track work, or per foot of special work. This system has been in force for six years and has given accurate and satisfactory results.

Replying to a question by Mr. Allen, Mr. Collins stated that work which has to be done regularly, such as cleaning cars, trucks, etc., was grouped under a separate head and did not come under the job order system.

The paper entitled "Some Notes on Electric Railway Shops and Shop Practice in Central New York," by W. H. Collins, of the Fonda, Johnstown & Gloversville Railway Company, was read.

Mr. Collins, in his paper, "Shop Practice," calls attention to the generally heterogeneous character of the shop equipment, and the inelasticity of the shops to meet expansion of the system. He summarizes his views as follows:

These repair shops are very inadequate. On account of the lack of suitable tools and sufficient room, they are not in a condition to handle work with the greatest economy.

In the rapid development of these electric railway properties, proper provision does not appear to have been made for the upkeep of the equipment. It now seems that we have reached a point where it is economically practicable to reconstruct our shops. While it is true that electric railway practice is changing, and will continue to change, yet it is sufficiently stable so that plans can be made for providing suitable buildings and tools to handle work with the minimum loss of time.

The harmonious arrangement which prevails in large manufacturing plants, when the process is continuous and where there is so little waste effort, is what we should endeavor to approximate in our repair shops. The buildings should be so arranged that the work can be moved along continuously through the different shops, with the minimum amount of handling.

The organization at these shops seemed to be the redeeming feature. There is a sufficient number of foremen, and the distribution of forces is the result of careful planning. But while each foreman is capable in his own line, it is seldom that one is found who is versatile enough to take the position of head of the department. This is the element of weakness general to the organizations.

With the advent of the large interurban cars, a new element was projected into electric railway shop practice. These cars are usually equipped with steel or steel-tired wheels, solid gears, etc., and range in weight from twenty-five tons to fifty tons. This class of equipment can not be compared with the ordinary electric railway equipment, but would seem to approximate more closely with steam locomotive practice. The writer believes that the methods and shop practices which will most successfully cope with this new problem in the traction field must be worked out along the lines which have proved so advantageous in the operation of steam railroads.

Opening the discussion, H. A. Benedict, electrical and mechanical engineer of the United Traction Company, said that each man had to work out his shop practice for himself. Each problem must be studied from its individual characteristics.

C. Gordon Reel, general manager of the Kingston Consolidated Railroad Company, said he makes no attempt to keep elaborate and detailed records of every little thing that is done about a car. When a car is overhauled, he writes out a new sheet for that car, with the principal repairs on the car, and tears up the old sheet. He found this worked out very well and resulted in considerable economies. He had learned in a small way that the only sensible and reasonable way to keep shop records is to make them just as simple as possible, and to keep records only of things that are needed. In that way the records of wheels and gears, controller bearings, axle bearings, armature bearings are kept. He doesn't care to know what a car did two or three or four or five years ago, but he did want to know when the last elaborate repairs were made on a car; and since he has adopted this system the shop repairs have been very much reduced because he proceeded intelligently.

C. Loomis Allen said that the whole question of shop practice upon electric railways is one that has not had proper

attention. He cited an instance of a road in New York state that twelve years ago had a shop that was sufficient for the proper maintenance and care of its equipment. In the past twelve years that equipment has become obsolete, though it is still in use; but the 100 cars which had been operated and have been replaced by another 100 cars are still maintained by the same shop facilities. A company's cars are its wares; they are what it has to offer the public, what it is selling. The condition of the car is one of the things by which the public judges the service; whether a car is dirty and unkempt and noisy or out of repair, whether its condition is not one that is presentable to the eye the public passes on those questions, and passes on them very quickly. He believes attention enough has not been devoted to the question of proper shop facilities to care for the equipment.

W. H. Evans thought it a good plan to standardize the trucks, particularly on double-truck cars, so that the body can be run in and changed over to another pair of trucks kept ready, and in the meantime have the defective trucks repaired and ready for the next body. In that way considerable time that the car would be out of service would be saved. It would be possible to arrange facilities whereby the body could be jacked up, put on other trucks and run through the paint shop or the wood shop if necessary, and in the meantime the trucks and motors could be entirely overhauled and put in first-class shape.

Upon a suggestion from Mr. Allen, considerable discussion was indulged in relative to the practicability of designing a standard shop, capable of expansion, which would be ample for present requirements, but so arranged that as the growth of the system required it the facilities could be logically and economically added to. The consensus of opinion appeared to be that under present conditions this was hardly feasible.

Upon motion of E. F. Peck, however, a committee of three master mechanics was appointed to report at the next meeting on the design of a model repair shop.

The session then adjourned.

### WEDNESDAY SESSION.

The Wednesday session was called to order at 10 A. M., and papers were read as follows:

"Recent Improvements in Motors and Control," by G. H. Hill, railway engineer, General Electric Company, and Clarence Renshaw, railway engineer, Westinghouse Electric and Manufacturing Company.

"Relation Between Maintenance of Way and Equipment," by W. R. W. Griffin, superintendent Rochester & Eastern Rapid Railway Company.

"Power," by S. B. Storer, Niagara, Lockport & Ontario Power Company.

Mr. Hill reviews in his paper the changes which have been wrought in car-motor equipment generally. Each part of the apparatus is discussed, the principal features are analyzed and a very clear picture of the relationship of the various parts is drawn.

Mr. Renshaw calls attention in his paper to the improvement in direct-current motors and the introduction of the "inter-pole" or auxiliary field-pole motor. The most important development in control apparatus is the perfection and standardization of unit switch-control equipment for all size of motors. This control is described and illustrated in detail. Attention is also called to the development of the single-phase electric railway development.

In the paper entitled "Relation Between Maintenance of Track and Equipment of Interurban Lines," Mr. Griffin calls attention to the importance of keeping the track in first-class condition. A proper care of the road-bed and the rails will reduce very materially the maintenance of cars and car equipment.

In his paper Mr. Storer holds that practically every large power company is today embodying in some form in its contracts the agreement that the price at which power is sold shall be dependent on the local factor. In a number of such contracts the question of measurement of the maximum demand is left entirely open —thus avoiding, for the time being, any vexatious disputes about peak loads. All this tends to simplifying the contract very greatly, but it will be found that the disputes will come sooner or later, and, realizing that fact, the writer has taken the ground that all disputes or possible misunderstandings should be thoroughly settled previous to the execution of any power contract.

It is to be regretted that many delays in delivery of apparatus and line material has so far postponed the supply of power by the Niagara, Lockport & Ontario Power Company, to its numerous customers that no adequate idea can be given at present as to the general working of the system. To the few consumers, however, who are now being supplied it seems to be entirely satisfactory.

As might have been expected, considerable difficulty has been experienced in getting a meter that will successfully measure a one-minute peak-load. The question is often asked as to why so short a time as one minute should have been selected in the determination of maximum demands, but such questions are nearly always prompted by the desire of a prospective buyer to get just as much for as little as he can.

One way of answering the question is by asking another one, *i. e.*, why should so long a time have been selected? As a matter of exact justice, there is no reason why power sold on a maximum demand basis should not be charged on the true maximum demand whether it lasted one second or an hour, or a day. Where power is sold on a kilowatt-hour basis, the consumer might just as well ask for an agreement whereby the kilowatt-hour should be calculated on the basis of seventy-kilowatt minutes as to ask that a maximum demand should not be deemed to have occurred unless it had lasted for several minutes.

Some power companies avoid disputes over duration of peak-loads in determining the maximum demand by incorporation in their contract form an optional use of one-second peaks, one-minute, three-minute or five-minute peaks, with a different rate per horse-power per year for each case. This use is, however, optional only with the power company. This is exactly in accordance with a statement made by the writer in the discussion following the presentation of papers on power matters last year, in answer to a criticism offered at that time; that is, a longer period than one minute could have been selected, but it would have meant a higher rate for the power in order that a proper revenue might be realized by power company.

It is also noticed that the highest maximum in the month is used in many places, rather than the average of the daily maximums, as the amount to be charged for. This also tends to simplify matters, but to the writer it does not seem to give an accurate or an equitable basis for charging. Of course it may be equalized to a certain extent by the price, but it could not be made to apply alike to all classes of consumers, at a uniform schedule of prices, without working an injustice to some.

The better method seems to be to set aside an amount of power for each consumer, that may be termed "firm" power or "reserved" power, which fairly represents the ordinary daily requirements; and to permit demands in excess of this amount within specified limits, to be

charged for only on the days on which they occur. In other words, it is much more equitable to charge for the average of the daily maximum demands for a given month than to make the single extreme maximum in the month the basis of such charge.

In conclusion it may be said that the movement for a fair and consistent way in which to supply electricity for all kinds of purposes, has reached such a proportion as to make it almost a certainty that within a comparatively short time it will be possible for any consumer, no matter what his needs, to obtain whatever he may require on such terms as to put him on an equality with all other consumers. And such an equality can never be obtained by the use of a straight kilowatt-hour charge, but only by the combined use of a kilowatt-hour charge and a maximum demand, or service charge.

There being no discussion, the convention proceeded to the election of officers, as follows:

President—Thomas W. Wilson, International Railway Company, Buffalo.

First vice-president—E. S. Fassett, United Traction Company, Albany.

Second vice-president—E. F. Peck, Schenectady Railway Company, Schenectady.

Treasurer—H. M. Beardsley, Elmira Water, Light and Railway Company, Elmira.

Secretary—J. H. Pardee, J. G. White & Company, New York.

Executive committee—C. Loomis Allen, Utica & Mohawk Valley Railway Company; C. Gordon Reel, Kingston Consolidated Railway Company; W. S. Darbee, Albany & Hudson Railway Company; J. C. Calisch, Buffalo & Lake Erie Traction Company.

The meeting then adjourned.

The banquet was held on Tuesday evening, W. W. Cole acting as toastmaster.

## The Technical Instruction of Practical Men.

Some very interesting work has been carried out by Sydney W. Ashe, instructor in electrical engineering and physics at the Polytechnic Institute, Brooklyn, N. Y., in giving technical instruction to a number of the employés of the Edison Illuminating Company of Brooklyn during the winter and spring just passed. So successful has been this work that Mr. Ashe has outlined his methods and presents them herewith in the hope that, possibly, other central stations may adopt similar means of affording to their men an opportunity to secure that information which will make them more efficient in their daily labor.

The course consisted of twelve lectures, which might be extended to twenty, one lecture each week. One night a week seems to be about the maximum number consistent with maintaining the interest of the men. A total number of lectures of twenty seems to be about the maximum, although where the attendance warrants the number could be increased to thirty.

In order to get a satisfactory attendance the following method is suggested: First, the preparation of a syllabus comprising notes on the lectures; second, the preparation of notices of each individual lecture, which should be posted on the bulletin boards at least three days before each lecture; third, the cooperation of the various department heads, and finally, last but by no means least, the lectures should be properly prepared and properly given. The only form of lecture which will maintain interest are experimental lectures. Each lecture should start promptly at eight o'clock, not later nor earlier. With each lecture there should be given about eighteen experiments. Actual observations should be made by arranging ammeters, voltmeters, galvanometers, etc., so that readings may be projected on the screen. Lantern slides, blackboard illustrations, simple problems, should form part of the lecture. The lecturer should be both theoretical and practical, primarily a teacher, and should not get beyond the reach of his audience. He should have a cool head, an appreciation of humor, and should not get confused when asked questions. He should make his audience feel that he is one of them. The lectures should be general, starting in with magnetism, proceeding to direct and alternating currents. The first year only the elementary principles and operating features should be dwelt upon with a view to future treatment. Lectures on the practical manipulation of shunt motors, the transformer, electrical measurements, the rotary converter, electrolysis, etc., can be demonstrated to excellent advantage with the apparatus on the lecture table and with projections on the screen.

Each step should be explained and a diagram of the set-up, no matter how simple, should be drawn on the blackboard. When measuring the resistance, say of the field coils of a motor, the ammeter and voltmeter readings should be projected on the screen if the direct-method is used.

## The Street Railway Convention.

The twenty-sixth annual convention of the American Street and Interurban Railway Association and the affiliated associations of the engineers, railway accountants, claim agents and manufacturers, will be held at Atlantic City, N. J., October 14 to 18. The following tentative programme has been announced:

Monday, October 14, 9.30 A. M., registration and badges; 2 P. M., meeting of Engineering Association and meeting of Claim Agents' Association.

Tuesday, October 15, 9.30 A. M. and 2 P. M., meetings of Accountants', Engineering and Claim Agents' associations.

Wednesday, October 16, 9.30 A. M., open session of American Association, and joint meeting of affiliated associations; 3 P. M., meetings of Accountants', Engineering and Claim Agents' associations.

Thursday, October 17, 9.30 A. M., meetings of American and Accountants' associations.

Friday, October 18, 9.30 A. M., meeting of American Association.

The opening session of the American Association, which is also a joint meeting with the affiliated associations, will be held in Casino Hall, a large audience room seating 800 people, located at the boardwalk end of the steel pier. The Thursday and Friday sessions of the American Association convention will be held in the sun parlor, which accommodates about 250 people, and is located near the outer end of the steel pier.

The meetings of the Accountants' Association will probably be held in a large audience room in the Chalfonte Hotel, which will be the headquarters of the Accountants' Association. All meetings of the Claim Agents' Association will be held in an audience room in the St. Charles Hotel, which will be headquarters for that association. The meetings of the Engineering Association will be held in the sun parlor on the steel pier.

The American Street and Interurban Railway Manufacturers' Association is announcing particularly attractive arrangements for its exhibition. The steel pier extends about 1,600 feet into the ocean, and has recently been widened and reinforced, so that there will be available about 83,000 square feet of exhibit space. Both alternating current and direct current will be available, as well as steam and compressed air. There will also be track space for track exhibits in close proximity to the steel pier.

# The Huronian Company's Power Development.[1]

By Robert A. Ross and Henry Holgate.

THE Canadian Copper Company operates numerous nickel and copper mines in what is known as the Sudbury District, the principal mines being at Copper Cliff, Creighton, and Crean Hill. The smelter at which these ores are treated is located at Copper Cliff. To develop and transmit power for their requirements and for other purposes the Huronian Company was incorporated.

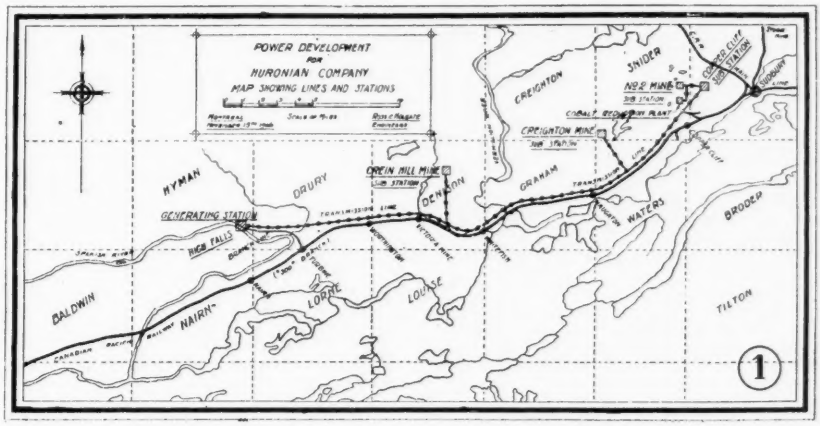
The cost of coal for operating the smelting plant and machinery at the mines induced the Huronian Company to acquire the property known as High Falls, on the Spanish river, in the township of Hyman, and in the spring of 1904 work was begun upon the development of this water power.

High Falls lies about four miles north of the "Soo Branch" of the Canadian Pacific Railway, at a point about twenty-eight and one-third miles west of Sudbury. A line of railway was built from the Canadian Pacific Railroad to the site of the works, and all necessary buildings were erected for housing the workmen and storing material. This preliminary work was ready about September 1, when work on the actual development was commenced.

The Spanish river, when it reaches High Falls, drains an area of 2,150 square miles. The average rainfall in this area is not in excess of thirty inches, and during one season, when the rainfall did not exceed twenty-four inches, the minimum discharge of the river was 1,600 cubic feet per second. The best description of the character of this watershed is found in Dr. Robert Bell's report in the geological survey of Canada for 1888-1890. It is owing to the nature of the covering of this watershed and to the numerous lakes in the upper reaches that the minimum flow is high, being 0.71 cubic foot per second per square mile. The minimum flow of the stream was reached in September, 1904, and also in February, 1905.

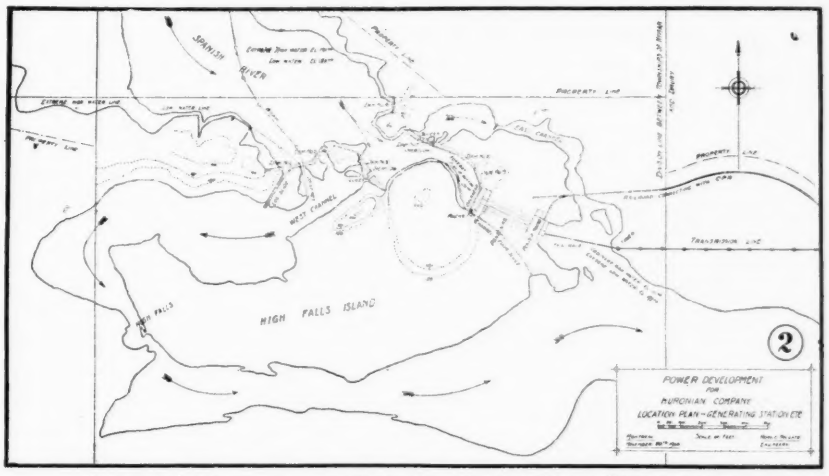
Above High Falls, for a distance of six miles, the river is a succession of rapids, and it was considered necessary that these should be drowned so as to prevent the formation of frazil, and to form as much of a reservoir as possible. For these reasons the river level above the falls was raised eighteen feet, drowning all troublesome rapids, providing a storage basin about six miles long, and increasing the head from sixty-seven to eighty-five feet.

The river above the falls flows between rocks and hills. Immediately at the head of the falls are rocky islands, which break the stream into several channels, finally dividing the river into the east and west channels, the two branches uniting a short distance below and thus forming High Falls Island.




LINES AND STATIONS, HURONIAN COMPANY POWER DEVELOPMENT.

The system of dams necessary to control the water was somewhat complicated, and work on concrete dams 1, 2, and 4 was begun first and carried on continuously to completion, notwithstanding the severe winter of 1904-5. At the same time the concrete foundations of the power-house were built to above high water so as to avoid any delay in the following spring. A log slide and two temporary openings were left in dams 1 and 2 so as to pass water when it became necessary to stop the water on the east side of the river. The channel on the east side was then closed up by a crib coffer-dam against a head of thirty-two feet of water. This coffer-dam was built in the form of the letter "V" in plan, each leg abutting on the rock projecting outwards and up stream at an angle and finished square, leaving a key-shape space between the two legs. Accurate measurements were made of this space, and a crib of these dimensions was built up stream a short distance, loaded, and then lowered with heavy tackle to within a short distance of its proposed location, and was then built up and loaded until it was within a few inches of the bottom. When this was completed the position of the key crib was adjusted; then it was lowered as far as possible under control of the ropes, and when the proper direction of its course was assured, the tackle was quickly slacked and the crib under the action of the current went into its position. The face of the coffer-dam was then double sheeted and




GENERAL LOCATION OF THE HURONIAN COMPANY POWER DEVELOPMENT.

[1] Read at joint meeting of the mechanical and electrical sections of the Canadian Society of Civil Engineers April 25, 1907.

made as tight as the bottom formation would allow, so that the water was thus diverted to the openings in dams 1 and 2.

As will be seen on plan No. 2, the water for the power plant was taken across the island, and to do this it was necessary to construct a series of dams, 5, 6, and 7, connecting with the bulkhead, and to close the west channel by dam 3, after which the openings in dams 1 and 2 were closed and in the forebay allowed to fill. All of the structures, including the power-house, are built on rock, and the forebay to elevation 170 is cut through rock. In dams No. 3 and No. 5 are sluices at level 159, which, with the aid of the log slide and penstock, allow (if ever it should be necessary) the water to be lowered to below 170 and render the racks and bulkhead accessible for repairs. These sluices are also intended to be used to relieve the overflow at high water, and are accessible by bridges from the shore ends of the dam.

As the river is used for lumbering purposes, and as large numbers of logs come down every year the provision for their passage was made in No. 2 dam, a system of booms being anchored above to guide the logs to the slide, which carries them to the west channel. In order to insure water in the west channel, the crest of dam No. 3 was made eighteen inches higher than dam No. 5, so that a continual flow is assured in the west channel for logging purposes.

From the photographs and general plan will be plainly seen the whole scheme of dams and works, which is of somewhat unusual design, but which was considered the best possible arrangement to secure the full flow of the river, to meet the lumbermen's demand, and also to make advantageous use of the physical peculiarities of the site.

Dams—All of the dams are founded on solid rock, ample key trenches being cut in the rock for anchorages, both in the foundation and end walls. The foundation rock was made absolutely clean, not a particle of dust or dirt was allowed to remain, the bottom was then dusted over with neat cement, and over this a layer of mortar 1 to 3 was laid to a minimum depth of four inches, when regular concreting was begun. The concrete mixture was all 1 cement, 3 sand, and 5 of broken stone, well mixed, and deposited in a very wet mixture. Larger stones were freely used, some measuring over two cubic yards, none being allowed nearer the face of the work than nine inches, nor nearer each other than twelve inches. All being carefully washed and scrubbed before placing, carefully bedded, and so disposed as to form as effective a bond in the work as possible, the wet condition of the concrete mass facilitating this bedding.

Though a large part of the concrete work in dams, and also in power-house foundations, was done in winter, with the temperature varying from a few degrees of frost to fifteen degrees below zero (and on several occasions much lower), no difficulty was found in securing good concrete work, the only precautions taken being to heat the mixing water by turning a three-fourths-inch steam pipe into the water barrel supplying the mixer, and, during the process of mixing, to use a jet of live steam in the mixer, keeping the cylinder closed by wooden coverings during the process of mixing. No attempt was made to heat sand or stone, nor was such at all necessary.

In all the winter work care was taken to use only cement which would attain its initial set in not more than sixty-five minutes, and the results obtained have been absolutely satisfactory.

Except in very thin walls there need be no hesitation in placing concrete in low temperature if the above precautions are taken. Even in thin walls (ten inches or over), it can be safely done, as was done in the case of the substation and blowing engine house constructed in connection with this plant at Copper Cliff, which was built during the winter of 1905-06, and which, except for the additional cost, does not differ from work done above the freezing point.

The sections of dams used are shown on the accompanying diagrams, Plan No. 5.

Bulkhead Wall—This was constructed generally in the same manner as the other dams, the steel structure for racks and the cones for penstocks being built in the work, all steel work being carefully bedded in and covered with wet mortar. The general arrangement of the bulkhead and penstock inlets are as shown on the diagram. The gates are of steel of split pattern, and are operated by a direct-current motor driven from the exciters, or by hand, as required. The exciter inlet is separate from the power-wheel inlets, so as to permit of a smaller screen spacing being used in the racks. This necessity at the inlet, and the advisability of having the exciters placed in the middle of the power-house floor, required the bending of the exciter penstock from the end of the bulkhead wall to a position in the centre of the power-house as the drawings indicate. The bulkhead was housed, so as to protect the operators in severe winter weather.

Penstocks—The entrance cones, built in the concrete wall, are ten feet in diameter at the upper end, and nine feet in diameter at the outside of the wall; the penstocks are nine feet in diameter from this point to the wheel cases, and are of steel plate, resting on concrete saddles, spaced at two diameters of the penstock centre. The penstocks are four in number and are anchored in the centre of their length, an expansion joint being provided near the bulkhead wall, and also one near the power-house in each. To prevent the formation of ice in the penstocks, they are covered with a wooden structure, made as nearly air-tight as possible, and this arrangement is quite effective and necessary in a plant operating in this locality, where the temperature sometimes reaches forty-five degrees below zero. The maximum speed of water in the penstocks is at full overload 7.2 feet per second. Air pipes of ample capacity, protected from freezing, are provided in the upper end of the penstocks.

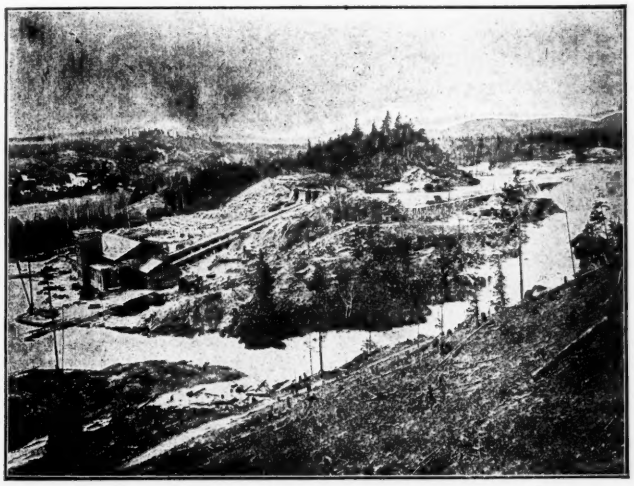
Power-House—The foundations of the building are carried down to rock, which dipped to the north and east at a depth of about thirty feet below the floor level. The overlying material was soft blue clay and quicksand, which gave a good deal of trouble in excavating, though the low temperature at which most of the work was done tended to facilitate rather than retard progress, as every opportunity was given the frost to penetrate the earth beyond the limits of the excavation, rendering the standard walls secure and enabling the excavation to be carried down on about plumb. The sub-floor work consisted of concrete walls, piers, and arches, as shown.

The floor arrangement of the power-house provides for two exciters in the middle of the room, each capable of serving four generators, both being furnished with water from one penstock, and each provided with an hydraulically-operated gate-valve. The power units are arranged with two on each side of the exciters. In the centre of the building is the switch tower, and on each side of it are the transformer compartments separated from the main room by steel doors. A railway track leads into the power-house, and an overhead crane commands all the machinery, the transformers being all mounted on trucks, which can be pushed forward so as to bring them under the crane.

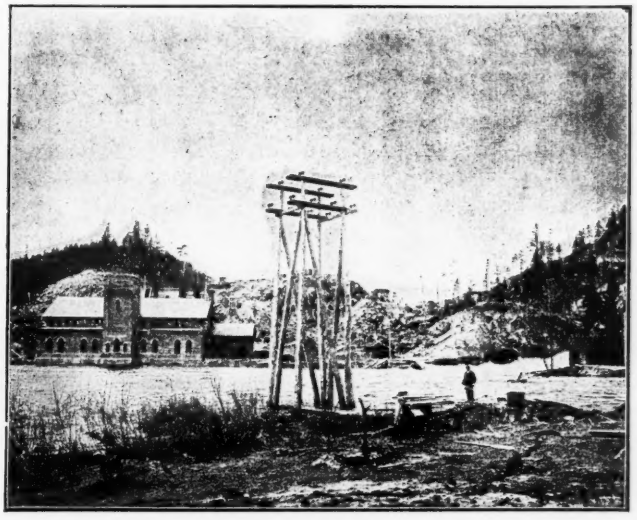
The base of the operating platform is faced with enameled brick, the platform itself being reached by a removable iron stairway at each side.

The roof of the transformer rooms and of the switch tower is of concrete, and the roof of the main building is of pine, two

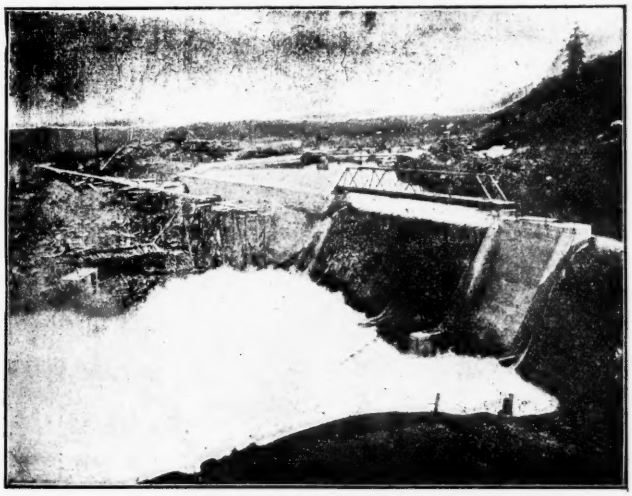
inches by four inches, laid on edge on steel trusses, and covered with twenty-six gauge galvanized iron. The building is heated from a boiler placed in a room on the east end of the building, the Sturtevant system of warm air being used. A room is also provided for stores and small repair work, furnished with a complete lavatory. The tail-race was excavated to ample size, and some necessary retaining walls and cribs were built for its protection.



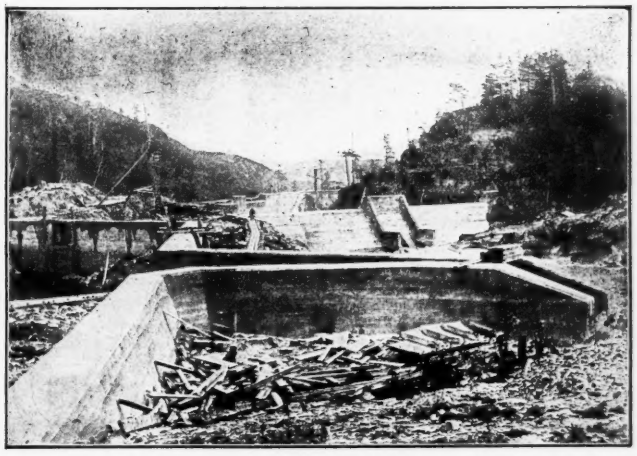
General Site, High Falls.



Power Station, High Falls.



Dam and Forebay.



Log Chute in Foreground.

The walls of the power-house were built of red brick, laid in a mortar consisting of Portland cement and lime; the inside well finished and the walls painted for six feet above the floor, while the remainder of the walls were tinted a buff color.

Turbines, etc.—The main turbine wheels were designed for a maximum of 3,550 horse-power each. Each turbine operated a 2,000-kilowatt generator, so that the wheels have a capacity sufficient for operating the generators at thirty-three per cent overload. The effective head is eighty-five feet, and the speed is 375 revolutions per minute. The wheels are enclosed in steel cases, with case and head split horizontally so as to give quick access to the moving parts in case of repairs being necessary. One pair of wheels is used in each unit, the diameter being thirty-four inches, the runner being of bronze. The thrust bearing is of the marine type, located between the wheel case and the generator. The case-head bearing is in effect merely a stuffing box and really takes no weight. The gates are of bronze of wicket design, being as nearly as possible balanced, and are operated by a governor of the Sturgess type. The exciter turbines are similar in design, and are also controlled by Sturgess governors; all governors are electrically controlled, being handled from the controlling desk by the operator on duty, who can start up any or all machines from this point. The total full-load capacity of the station is 8,000 kilowatts.

Tachometers are attached to each main unit.

Generators—The electrical plant was designed for the eventual installation of four generators, two of which are at present operating, and a third has been contracted for. These generators are each of 2,000-kilowatts capacity at eighty per cent power-factor, three-phase, twenty-five cycles, operating at 2,400 volts. The revolving field is mounted on a steel shaft with the coupling forged out of the solid and directly connected to the water-wheels.

Exciters—The exciters, two in number, are of 200-kilowatts capacity each, operated at 550 revolutions per minute, each being of a capacity sufficient to furnish excitation for the four generators. These exciters are also directly connected to their own wheels.

In connection with the testing of the generators, it may be interesting to note that loads were obtained by connecting one generator up as a motor reversed in direc-

tion of rotation and operating it from the other machine running as a generator. Both machines, for the purpose of the tests, were brought up to full excitation and switched together before being started up. The gates on the generator wheel being opened up gradually, both machines came up to speed, the motor, of course, driving its wheel in the opposite direction to normal rotation. When both machines were at speed, the gates on the wheel connected to the motor were gradually opened, thus obtaining practically a water-brake load. It was possible by this means to get any load required, and also to reach any power-factor by over or under exciting the synchronous motor, thus determining the regulation of the generator at any power-factor. This scheme is decidedly superior to a water rheostat load, which, in addition to troubles of its own, gives only a fixed power-factor.

Switchboard—The switching arrangement was laid out so that any generator, set of transformers, or line might be operated together or operated singly in any combination.

The marble bench board from which the operation of the station is controlled in every particular, including the speeding of the water-wheels, was placed on a gallery to give the operator a clear view of the power station and the switching apparatus in the tower. The switches, being distantly controlled, are placed on two floors of the switching and line tower, the 35,000-volt outgoing line switches, together with the lightning arresters, being placed at the top of the tower, and the 2,200-volt apparatus in the base, so that on the bench board the only voltages are those from the exciter and the operating voltages from the switch controls. In other words, nothing higher than 125 volts is admitted to the main power station, except within the generators themselves, which have no exposed parts, and the current from which is carried by cables in ducts to the low-voltage chamber in the switch tower.

All of the bus-bars, switches, etc., in the tower, are properly barriered by concrete slab construction.

The bench board is low, and instead of using marble panels for the instruments, which would have obstructed the view of the station, ornamental pillars, carrying all instruments, were installed along the face of the controlling platform.

All switching and other operations are governed by small control switches, with indicating lamps on the board; and on the wall, opposite the bench board, is set a large synchroscope and the visual and bell signal system for each power unit. A synchronizer is also located on one of the instrument pillars.

In the compartment below the bench-board platform is located the motor-driven air-compressor, used to supply air for cleaning purposes. This air is piped to a number of accessible places throughout the main floor, transformer rooms, and also to the tower for cleaning lightning arresters, etc.

The exciter and generator field rheostats are also located in this compartment.

Transformers—Two groups of three transformers each were installed with the first equipment, and the third set has been contracted for. These are placed in a transformer room extending along the entire length of the power-house and subdivided into four compartments, thus isolating each group of three transformers from the rest.

The specifications for these transformers required that the cases were to be constructed entirely of boiler iron, designed to withstand an explosive pressure of 150 pounds per square inch, and so arranged as to be full of oil at all times, being kept in this condition by means of a system of piping extending to an expansion tank on the wall, which was carefully covered. With the precautions taken, no space in the cases is allowed for gas to accumulate and, therefore, no explosions will be possible under proper supervision. If, however, through carelessness, the oil were to be allowed to sink below the level of the tops of the transformers and an explosion should take place, no harm would be done outside the case, as the pressure generated by an oil-gas explosion is never over 100 pounds per square inch.

In case of a short-circuit in the coils, the heat generated expands the oil and throws it into the tank, which also provides for the inevitable expansion and contraction of the oil in the transformer cas as the apparatus heats up or cools off.

This is the first time the engineers have used this scheme in their practice, and owing to its success in this plant will continue to use it for all future work.

For handling the oil, a piping system is provided, with an underground tank at one end of the building, divided into two parts; one for spare clean oil, and the other for dirty oil, the latter running from the transformer to the tank by gravity, while the clean oil is forced into the cases as required, by compressed air, which is obtained from the air-tank and compressor used for blowing dust out of the generators and switches.

Some strenuous criticisms were offered to this method by the transformer builders who took the ground that moisture from the air, under compression, would be sure to be forced into the oil, thus rendering it unfit for use. To demonstrate the fallacy of this, a quantity of oil was forced by air backwards and forwards a number of times into and out of two inter-connected vessels, and after this test absolutely no moisture could be detected. It may be stated, however, that no air is taken directly from the air-pump, but from the air-pump tank in which all the moisture due to compression is deposited. As the air-compressor for blowing out purposes is essential in any modern plant, this scheme affords a means of handling the oil safely and economically.

Fire Protection—For fire protection of the wooden penstock covering, bulkhead structure, and other buildings, a 500-gallon, two-stage turbine pump, directly connected to a fifty-horse-power direct-current motor and supplied with current from the exciter circuit, has been located between units Nos. 1 and 2, with water connection to both penstocks, so as to insure at all times a supply of water to the pump. From the pump a dry pipe-line has been run with outlets at various points along the penstock, and a line has also been carried over to protect the houses of the employés.

Transmission Line—The transmission line from High Falls to Copper Cliff, operating at 35,000 volts, is about twenty-nine miles long, and runs for the most part upon a right of way acquired immediately outside that of the "Soo Branch" of the Canadian Pacific Railway, thus affording ready access from the railway at all points. The line consists of two three-phase circuits of No. 1 wire, one line being transposed three times, and the other running straight through.

The telephone line was placed on the Canadian Pacific Railway Company's telegraph poles on the opposite side of the track, at a distance of about eighty feet, to avoid the possibility of induction.

The pole-line construction utilizes specially designed malleable iron pins, with a double-pole construction throughout. Owing to the wide spacing of wires, it would be impossible to carry the two circuits on one pole, so that in the interest of structural stability it was advisable, instead of installing a second pole-line, to combine the two with a common cross-arm; these cross-arms being made of long leaf Southern pine. This gives a very solid structure, and eliminates a lot of guying and strutting, which is always objectionable.

The insulators were tested at the works

of the makers by a representative of the engineers for a period of fifteen minutes at a voltage of 70,000, and the result of this very rigid test, especially as regards time, was that the lines were energized without a single breakdown. Since that time they have given absolutely no trouble, except where insulators have been shattered by bullets or other missiles.

The high-tension exits of the lines from the power station and entrances to the substations have been made through the substations, but simply to open the branch lines in case any repairs were necessary while the main line was alive. These aerial switches are both connected to the same line, the other main line running straight through to Copper Cliff substation.

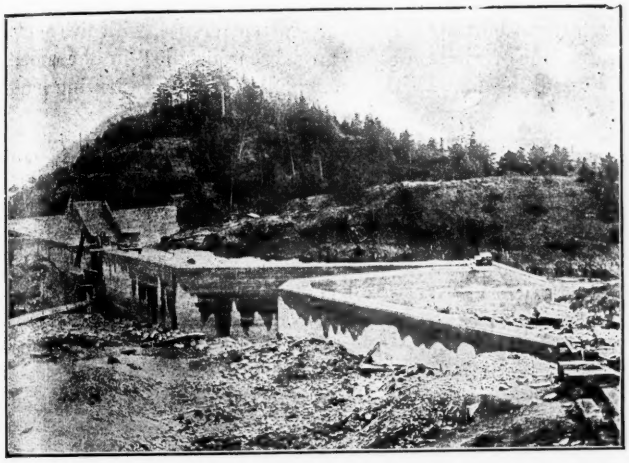
Substation, Copper Cliff—The main substation is at Copper Cliff, and contains, in addition to electrical apparatus, some very interesting machinery for the operation of the smelter, etc., as follows:

Thirteen feeder and control panels for transformers, motors, lighting, etc.

One storage battery for operating distant-control switches.

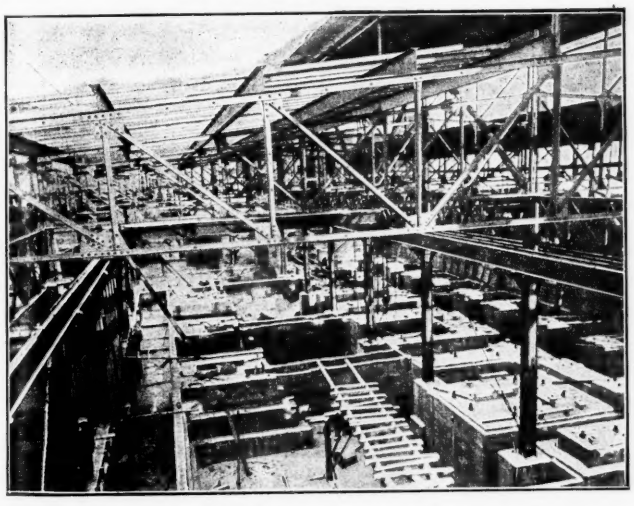
Seventy-five-light capacity in constant-current alternating-current arc regulators.

Three 600-horse-power induction motors, each connected to a blowing engine having a capacity of 35,000 cubic feet of air at forty-ounce pressure. These blowing engines are driven by the motor with eighteen 1½-inch manila ropes on the



Dam on West Side of River.

No. 3 Dam and Forebay.



Main Substation, Copper Cliff.

Main Substation, Copper Cliff.

eighteen-inch tiles with plate-glass screens, and have given no trouble, except at the substation at Copper Cliff, where sulphur fumes and metallic dust from the smelter have deposited from time to time, forming a scum, over which leakage has taken place. This has been remedied.

Aerial switches for isolating the branches to Crean Hill and Creighton mines, as shown on photographs, have been located at Victoria mine and the Quartz quarry. These switches were not designed to open the circuit with any load on at

ELECTRICAL EQUIPMENT.

Six 667-kilowatt transformers, 35,000 to 2,400 volts.

Three 175-kilowatt transformers, 2,400 to 575 volts.

One 40-kilowatt motor-generator set, 575 alternating current to 250 direct current for operating furnace charging locomotives.

One 75-kilowatt frequency changer set, 25 to 60 cycles, for operating the alternating-current series arc circuits used for lighting the streets.

English system. The motors are fitted with a special speed-changing controller, arranged for controlling speed by changing the number of poles in stator, with electric locking device to prevent the operation of controller when motor is in operation. These motors are mounted on base-rails, and are fitted with the regular starting compensators and circuit-breakers.

One 300-horse-power induction motor directly connected to a compound air-compressor operating at 100 pounds pressure and 120 revolutions per minute. The speed

of this motor is constant, the compressor being fitted with an unloading device, which is automatically brought into use when the pressure rises or falls below 100 pounds. This motor is fitted with starting compensator and circuit-breaker.

One 500-horse-power induction motor, constant speed, operating at 375 revolutions per minute, connected to a blowing engine having a capacity of 10,400 cubic feet of air at twelve pounds pressure, and driven by sixteen 1½-inch manila ropes on the English system. This motor is mounted on sliding base rails, and is equipped with the regular starting compensator and circuit-breakers. Space is provided for a second blowing engine of the same capacity as above engine.

One four-stage, six-inch turbine pump directly-connected to a 225-horse-power induction motor; this outfit being used for fire protection, is connected to a dry fire line, which is piped around yards and buildings. The supply of water to this pump is taken from a sixteen-inch water main under twenty pounds pressure, being obtained from a series of small lakes by gravity.

One two-inch vertical pump and direct-connected motor, with automatic starting switch, operated by a float, is used to pump the water from the sump, which is located in the basement. The transformer cooling water drains into this sump, as well as any seepage.

Two eight-inch, single-stage, turbine pumps directly connected to eighty-horse-power induction motors, housed in a separate pump-house, which are used to circulate the water supply to the furnace jackets.

One five-inch, two-stage turbine pump directly connected to a fifty-horse-power induction motor is located near the smelter furnace gallery, which pump is held in reserve in case of the molten metal burning its way through between the furnace jackets. This pump is used to supply water to chill same and stop the flow of metal.

One ten-horse-power induction motor belted to a Sturtevant blower and located in substation, is used in connection with the hot-blast heating system of the substation.

It will be noted that the motors here installed are very large, and being connected to air-compressors of great size, take a very large amount of current on starting up. Owing to these conditions, the lighting is by no means as perfect as if the motor units were smaller, but no serious trouble has been encountered from this cause.

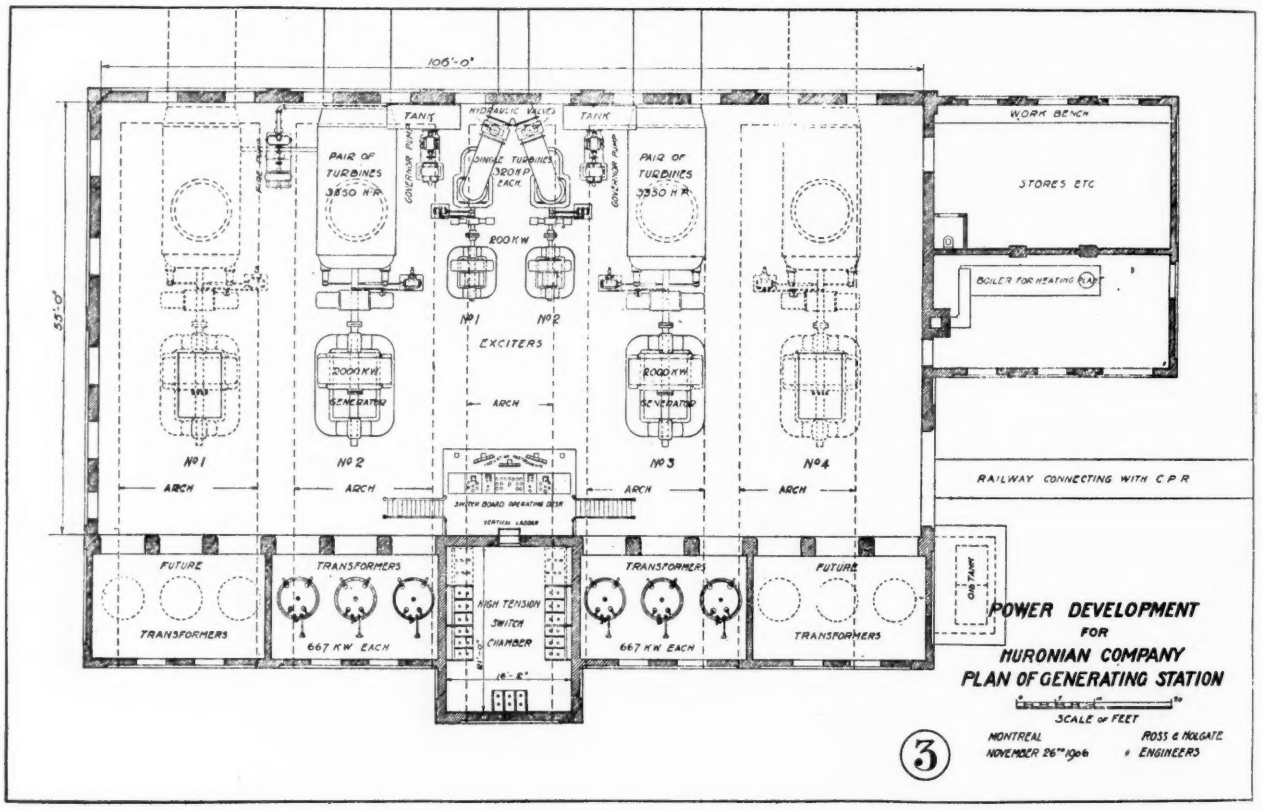
This substation is constructed entirely of concrete, with a steel frame and book tile roof, and covers approximately one-half acre of ground.

The apparatus contained in this station, including two ten-ton cranes, together with all the air-piping to the smelter, was contracted for and installed by the engineers of the Huronian Company's plant, the whole forming a rather interesting application of electricity for mining and smelter purposes.

Cranes—In addition, two forty-ton alternating-current cranes, with five motors each, have been installed in the smelter for the handling of ladles carrying melted matte, and in spite of predictions to the contrary, these handle perfectly, pouring the metal into the converters as readily as by a hand ladle. These alternating-current motors operate under the most adverse conditions, in an atmosphere of tremendous heat and covered with sulphur fumes and metallic dust from the furnaces and converters.

The converters also are tipped by alternating-current motors from a controlling stand some distance away.

Crean Hill Substation—This substation is connected to the first branch taken off one of the two main transmission lines, which is approximately three and one-half

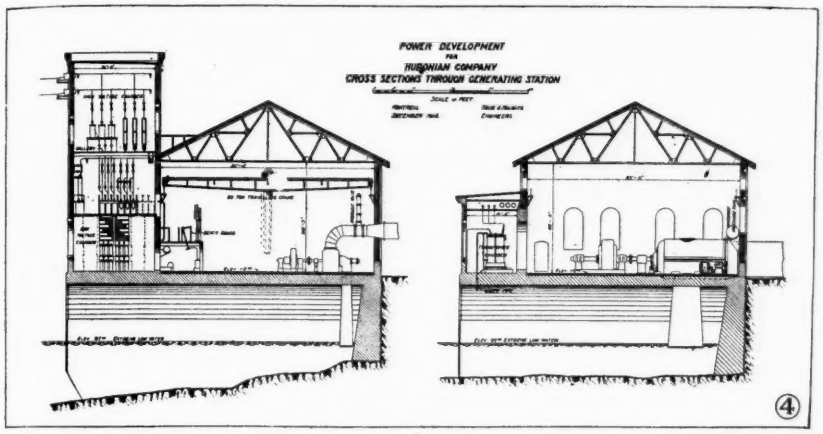



PLAN OF GENERATING STATION, HURONIAN COMPANY POWER DEVELOPMENT.

miles long and of single-pole construction, with special aerial switches located at point of departure from the main line.

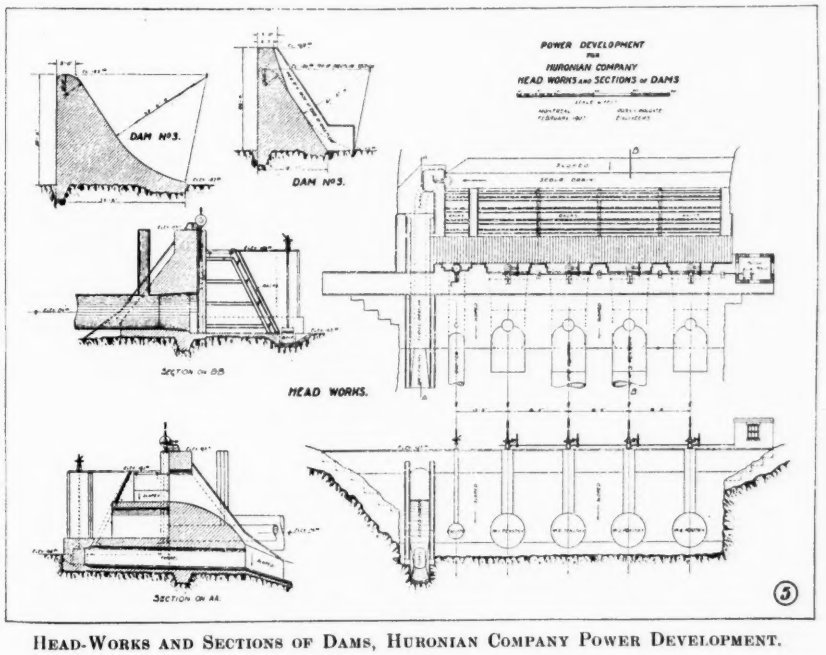
The substation building is constructed of concrete and brick and provided with a ten-ton hand-power traveling crane.

For the housing of lightning arresters, high-tension line switch, choke-coils, disconnecting switches, etc., a tower has been provided in one corner of the building.




CROSS-SECTIONS THROUGH GENERATING STATION, HURONIAN COMPANY POWER DEVELOPMENT.

For the reception of the 3-175-kilowatt, 35,000 to 550-volt, oil-filled, water-cooled transformers, a special fireproof compartment has been provided with iron doors, so as to completely isolate the transformers from the main building, this being practically the same scheme as followed at the main power-house at High Falls.




HEAD-WORKS AND SECTIONS OF DAMS, HURONIAN COMPANY POWER DEVELOPMENT.

For the control and distribution of power to the various receivers throughout the mines, the necessary totaling and feeder-panels have been provided, the cables to and from same being run in fibre conduit and laid in the concrete floor.

Air Supply—For supply of air to the mines, a compound, direct-driven air-compressor has been supplied, operating at 120 revolutions per minute and supplying 1,635 cubic feet of free air per minute, with an intercooler of extra large capacity. As the speed is constant, regulation is obtained by automatic Corliss valve-step regulation.

For driving the compressor, a self-contained, three-phase, 550-volt induction motor has been installed, with the motor mounted on the main shaft of the compressor, operating at 120 revolutions per minute and provided with all the necessary starting compensator, circuit-breakers and panel.

Mine Hoist—In connection with the operation of the mine skips, a special three-drum mine hoist has been installed, the drums of which are arranged for the operation of two drums in counterbalance, also independently, or all three together if necessary. The rope speed is 500 feet per minute, and the capacity of each skip 6,000 pounds.

For the operation of this hoist, a 150-horse-power, three-phase, variable-speed induction motor has been provided, complete with reversing controller, resistances, circuit-breaker, panel, etc.

Fire Protection—For the protection of the buildings and plant, a 1,000-gallon, six-inch, four-stage fire-pump directly-connected to a 150-horse-power, three-phase, 550-volt induction motor has been installed; also a dry fire line has been piped to various points throughout the plant.

Cooling Water for Compressor and Transformers—The water for cooling the compressor and transformers is kept in circulation by the aid of a 250-gallon, three-inch, single-stage centrifugal pump directly-connected to a five-horse-power, three-phase, 550-volt induction motor, operating at 1,500 revolutions per minute.

Water Supply—For storage of water for the fire-pump supply, a steel tank holding 60,000 gallons has been erected close to the substation, the water for this tank being obtained from a lake 3,000 feet away, at which point a 250-gallon, four-inch, two-stage turbine pump, with a twenty-horse-power, three-phase, 550-volt induction motor directly connected to same, and operating at 1,500 revolutions per minute, is located. For the reception of this outfit a concrete and brick building has been erected.

Rock House Equipment—After the skips have delivered their loads, hoisted from the mine to the grizzly, the ore falls by gravity on the spalling floor, and from there is fed into crushers, which are thirty inches by eighteen inches. After passing through the crushers, the crushed ore passes through special revolving screens, the perforated plates of which are constructed of manganese steel. After passing through the screens the ore falls on the picking belts, each of which is thirty-six inches wide and approximately fifty feet between pulley centres. All necessary hoppers, chutes, troughing idlers, etc., are supplied for delivery of the ore into the various ore pockets provided for its reception. The cars into which the ore is finally loaded pass below these pockets, into which the ore is fed by gravity.

The power to operate each crusher, with its complement of screens and picking belts, is obtained from a fifty-horse-power,

three-phase, 550-volt induction motor of the wound-rotor type, operating at 500 revolutions per minute, by means of belting and shafting.

Mine Pumps—For clearing the mines of water there have been provided special single-acting, vertical, triplex, brass-fitted pumps, each having a capacity of 100 gallons per minute against a head of 250 feet, each pump being connected by gearing to a fifteen-horse-power, three-phase, 550-volt induction motor, operating at 750 revolutions per minute.

Creighton Mine Substation—The substation at Creighton mine is almost exactly similar to that at Crean Hill, and is connected to the second branch line from one of the two main transmission lines, this branch line being about three and one-half miles in length. It is of single-pole construction, and has special aerial switches located at the point of departure from the main line.

The building itself, the switching and lightning-arrester tower, the transformer compartment, and the switchboard arrangements are almost exactly like the corresponding items at Crean Hill, except that the three transformers have a capacity of 275 kilowatts each, instead of 175 kilowatts.

The apparatus for supplying air to the mines is the exact counterpart of the Crean Hill compressor outfit. There are two mine hoists at Creighton for handling the ore, instead of one as at the former mine.

The devices for fire protection, transformer, and compressor cooling water, and the tank and apparatus for water storage for the fire-pump supply are also the same as the corresponding apparatus at Crean Hill, and the rock-house equipment and the mine pumps will, when completely installed, also carry out the general idea of duplication.

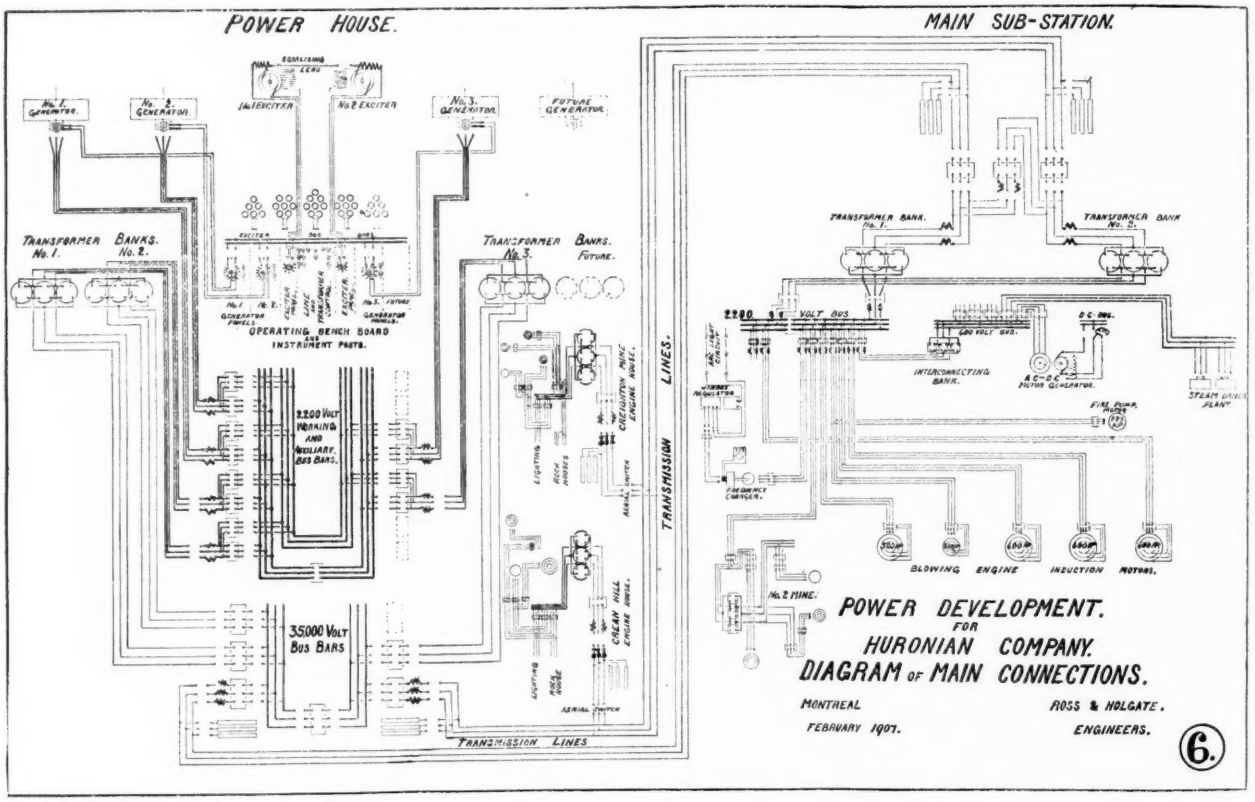



Diagram of Main Connections, Huronian Company Power Development.

No. 2 Mine Substation—No. 2 mine, situated in Copper Cliff, has its substation situated approximately one mile distant from the main substation. The building, as in the other cases, is constructed of concrete and brick, and has a similar ten-ton crane to handle its apparatus. The supply of current for all purposes is obtained directly from the main substation at 2,300 volts, three-phase, sixty cycles. Part of the machinery in this building is operated at the above pressure, and part at 550 volts, the control of which is through totaling and feeder panels. Three 125-kilowatt transformers, oil-filled, natural-cooled, reducing from 2,300 to 550 volts, are located in a special fireproof compartment.

The air-compressor apparatus is the same as those at Crean Hill and Creighton, except that the driving motor is wound for 2,300 volts.

There is installed for operating the mine skips a special double-drum hoist, arranged for the drums to operate in counterbalance or independently, and, as in the other cases, the rope-speed is 500 feet per minute, and the capacity of each skip is 6,000 pounds, a similar motor to the other hoist motors being provided for its operation.

The fire protection apparatus duplicates that installed at the other two mine substations, the supply of water for the pump being obtained by tapping a sixteen-inch main, which supplies water to the smelter, while the water for cooling the compressor is circulated by a similar centrifugal pump to those at Crean Hill and Creighton. This applies also to the mine pumps.

For the operation of the machinery in the rock-house building, a fifty-horse-power, three-phase, 550-volt induction motor of the wound rotor type has been installed, all connections to crusher, etc., being by belting.

The Cobalt Smelter Substation—This

substation is located in Copper Cliff, and is approximately two miles distant from the main substation. The building is constructed of concrete and brick, and contains three seventy-five kilowatt, oil-filled, natural-cooled transformers, receiving current at 2300 volts, three-phase, twenty-five cycles direct from the main substation and reduced to 550 volts and distributed through control and feeder panels.

In this building is also located a 1,000-gallon, six-inch, four-stage turbine fire-pump directly connected to a 150-horse-power, three-phase, 550-volt induction motor, with control panel, also a dry fire line has been piped to various points throughout the plant.

The supply of water to this pump is obtained under twenty pounds pressure from the domestic service pipes fed from the storage reservoir.

Throughout the smelter the following three-phase, 550-volt induction motors are installed: three fifty-horse-power, running at 500 revolutions per minute; one thirty-five-horse-power, running at 750 revolutions per minute.

The plant was put into operation in February, 1906.

## The History of Mathematics.

In this able paper, entitled "A Plea for the Study of the History of Medicine and Natural Sciences," Berthold Laufer refers briefly to the history of mathematics. The relation of the concepts of mathematics to the human mind and to the development of culture is still a matter of controversy. The historical position of mathematics is as yet very far from being defined, and no criterions are agreed upon which will at the outset admit of stamping a mathematical thought and theorem as borrowed or independent. The most striking feature in the history of this science is the fact that the same results, even in the highest branches of it, have frequently been found by different peoples, and at various epochs, with little or no possibility of pointing out historical connection between such coincidences. The quadrature of the circle, for example, was made the object of correct speculation in China even in pre-Christian times; and the rule of Horner "for solving equations of all orders," established in 1819, was known to the Chinese 520 years earlier, when, in an arithmetical treatise published in 1299, roots were extracted as high as the thirteenth power. To us mathematics is essentially an outcome of human culture, and the question arising from an anthropological viewpoint is, are the phenomena of mathematical thoughts to be considered as on an equal footing with those of language, religion or medicine, and accordingly capable of methodical anthropological treatment, or are they the particular productions of individual thinkers, and accordingly conducive only to an exclusively historical analysis?—*Abstracted from Science (Lancaster), June 7.*

## THE USE OF WOODEN POLES FOR OVERHEAD POWER TRANSMISSION.[1]

BY C. WADE.

*(Concluded.)*

### SINGLE POLES.

The results of isolated tests of poles are of little value unless data can be derived from them which can be utilized in calculating the probable behavior of poles in general. In the treatment followed the timber was assumed to be perfectly elastic for working stresses, and further, that the ordinary formulas for elastic beams hold for timber. It is well known that, although such assumptions are not altogether justifiable, they give correct relative results. The beam formula only professes to be true for elastic materials, therefore it should not be used for calculating the breaking strength of beams unless a suitable "Modulus of Rupture" be

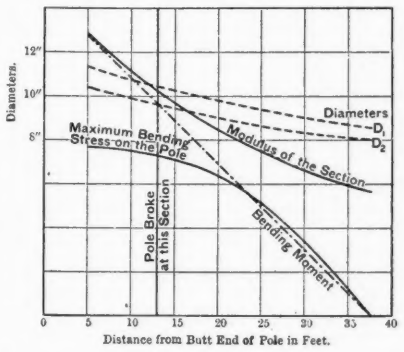



FIG. 11.—DISTANCE FROM BUTT END OF POLE IN FEET.

taken in the place of the ultimate strength of the material. The tests on single poles described in the preceding section of this paper supply this datum; but since the number of single poles tested was too small to generalize from, the modulus of rupture obtained in former post-office tests was adopted in calculating the tables of the breaking strength of single poles. A comparison between the results obtained by the British Post-Office and in the tests by Mr. Wade and the author is, however, of interest. In addition to the tests made in the timber yard further bending tests were made in the Buckton testing machine at the Leeds University, England.

In the experiments on the breaking strength of single poles it was found that they did not break where expected, *viz.*, at the section close to the ground where the stress was greatest, but at a section six or seven feet above the ground. The actual bending stress at various heights above the ground is shown in the accompanying diagram (Fig. 11), from which it will be seen that the pole actually broke at a section where the stress was less than at the ground level. It was thought that this peculiarity might be due to the strength of the timber being greater at the butt than at sections higher up the pole, but the following bending experiments made on different pieces of the same pole in the testing machine shows that this was not the case:

TABLE I.

| Diameter in Inches. | Modulus of Rupture in Tons per Square Inch. | Position of the Fracture. |
|---|---|---|
| 7.5 | 3.15 | About 8 ft. from butt. |
| 7.2 | 2.94 | " 14 " " " |
| 6.7 | 3.10 | " 20 " " " |
| 6.2 | 3.09 | " 26 " " " |
| 5.4 | 2.92 | " 32 " " " |

### WIND PRESSURE.

The chief lateral stresses to which telegraph and overhead transmission poles are subjected are due to wind pressure acting on the wires and on the poles themselves. The wind pressure assumed by the Board of Trade for high-voltage overhead transmission work is thirty pounds per square foot, which in the opinion of many is far too high for inland work, but it may not be excessive for very exposed positions on the coast. The above-mentioned pressure is for the wind acting normally to a flat surface; in the case of a cylindrical surface, such as a wire or pole, the resistance to the wind is only 0.5 to 0.66 of that on a flat surface; for the wires assume the higher value, *viz.*, 0.66, and the lower value for the poles, mainly because it is well known that the pressure of the wind diminishes as the ground is approached.

### "A" POLES.

The theoretical treatment of single poles is a tolerably simple matter, and can be relied upon within narrow limits, but the same can not be said with regard to "A" poles, as there are so many uncertain factors. If one could be quite certain of the joint at the apex of the poles and knew exactly the conditions as regards the end holding, he could probably obtain from first principles quite reliable expressions for the strength and behavior of such poles; but since both of these are very uncertain quantities, it is necessary to resort to experiments. The tests made give data which are believed to be quite reliable, and it only remains to reduce the results to such a form that the probable behavior of all similar structures can be calculated. This was done with the results given later in this paper.

It will be seen that when an "A" structure is loaded, one leg is subjected to tension and the other to compression; the

[1] Appendix by Professor Goodman Condensed. From a paper read before the Institution Electrical Engineers of Great Britain.

structure may therefore fail by tearing apart the tension pole, by buckling the compression pole, or by shearing the apex joint. With the exception of one faulty pole, none of the "A" poles tested failed in tension, therefore one need not further consider the strength from this point of view. Several, however, failed by shearing at the top joint (see results quoted later). This source of weakness was, however, overcome by adopting an improved joint, which was the outcome of these tests, and details of which are given in the preceding section of this paper. Most of the poles failed when under test through the buckling of the compression pole.

If the pole were pivoted at both ends, or were otherwise arranged so that it would be free to bend in any direction, the buckling load could be readily calculated; similarly if it were held rigidly at one or both ends; but, as a matter of fact, it is neither a simple case of rigid holding nor pivoting, hence it is necessary to find by experiment what is approximately the system of end holding. If the pole were pivoted its equivalent length would be equal to its actual length, and if it were rigidly held at both ends its equivalent length would be one-half its actual length. The tests appear to show that owing to the central stay and the scarfing of the joint this is about the equivalent length of the compression member of an "A" pole.

The results of the tests upon both types of pole are given in Table II, where the symbols designate the following qualities:

W = the breaking load in pounds applied at a point two feet from the top of the pole.

$R_1$ = the radius of the pole at the ground level, in inches, in the plane of bending when not truly circular in section.

$R_2$ = ditto, normal to the plane of bending.

TABLE II.

TABLE OF RESULTS.

| Index. | Splay at Foot of Pole in Inches. S. | Overall Length of Pole in Inches $L_o$. | G. Inches. | L. Inches. | T. Inches. | Radius at Ground Level in Inches. $R_1$. | Radius at Ground Level in Inches. $R_2$. | Breaking Load in Pounds. W. | Breaking Load in Pounds. K. | Elastic Deflection in Inches under a Load of 1,000 Lbs. $D_e$ | Elastic Deflection in Inches under a Load of 1,000 Lbs. D. | $d$. Inches | Remarks. (The figures referred to were given in the first section of the paper. Some were not shown in the abstract published herein. Figs. 11, 12 and 13 herewith.) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $a$ | — | 476 | 64 | 386 | 26 | 5.6 | 5.4 | Approximate 2,200 | Approximate 1,100 | 20.00 | 18.20 | 8.30 | Unseasoned Swedish fir, not creosoted. | Single Poles. |
| $b$ | — | 485 | 64 | 392 | 26 | 5.5 | 5.2 | Not broken | | 23.00 | 20 80 | 8.20 | Ditto. ditto. | |
| $c$ | — | 478 | 64 | 387 | 27 | 5.2 | 5.5 | 1,860 | 1,030 | 30.00 | 27.20 | 10 00 | Unseasoned Russian fir, creosoted. | |
| $d$ | — | 444 | 70 | 351 | 23 | 5.1 | 4.7 | Approximate 2,480 | 1,457 | 17 00 | 15.50 | 7.20 | Seasoned Swedish fir, not creosoted. | |
| $e$ | 25 | 384 | 64 | 291 | 29 | 5.4<br>5.5 | 5.5<br>5.5 | Not broken<br>Max. load 3,050 | | 3.00 | 2.61 | 2.61 | Russian fir. See Fig. 10. No chocks. | Imperfect method of holding foot of pole. |
| $e_1$ | 25 | 384 | 64 | 291 | 29 | 5.4<br>5.5 | 5.5<br>5 5 | Not broken<br>Max. load 3,430 | | 2.97 | 2.58 | 2.58 | Ditto, after fitting three oak chocks in apex. | |
| $f$ | 25 | 385 | 64 | 295 | 26 | 4.4<br>4.4 | 4.6<br>4.7 | Not broken<br>Max. load 3,220 | | 8.20 | 7.10 | 3.00 | Swedish fir. See Fig. 10. No chocks. | |
| $f_1$ | 42 | 385 | 64 | 295 | 26 | 4.4<br>4.4 | 4.6<br>4.7 | Not broken<br>Max load 3,180 | | 10.00 | 8.70 | 3.70 | Ditto, after splaying out at bottom. | |
| $g$ | 24 | 436 | 46 | 362 | 28 | 3.9<br>4.0 | 4.0<br>4.2 | 2,780 | 3,346 | 2.40 | 2.15 | 0.32 | See Fig. 11. Two chocks. Tension pole broke through top bolt hole at 2,050 lbs. square inch of net section. | "A" poles tested on edge, *i. e.*, at right angles to the wires. |
| $h$ | 36 | 432 | 46 | 366 | 20 | 4.0<br>3.9 | 4.3<br>3.9 | 3,920 | 4,766 | 2.30 | 2.13 | 0.30 | See Fig. 11. One chock. Failed by shearing the top of the pole beyond the oak chock. | |
| $i$ | 48 | 433 | 43 | 370 | 20 | 3.7<br>4.1 | 3.8<br>4.0 | 4,160 | 5,496 | 0 95 | 0.88 | 0.11 | See Fig. 11. Two chocks. Failed by buckling the compression pole. | |
| $j$ | 48 | 435 | 43 | 373 | 19 | 3.7<br>3.9 | 4.1<br>3.9 | 3,800 | 5,224 | 0.95 | 0.88 | 0.11 | Ditto. | |
| $k$ | 60 | 434 | 46 | 369 | 19 | 4.0<br>3.7 | 4.2<br>3.7 | 5,400 | 7,192 | 1.10 | 1.02 | 0.14 | See Figs. 11 and 17. One chock. Failed by crushing and rotation of the oak chock. | |
| $l$ | 72 | 433 | 47 | 367 | 19 | 3.8<br>3.9 | 3.8<br>3.9 | 5,450 | 7,453 | 0.60 | 0.56 | 0.07 | See Fig. 11. Two chocks. Failed by buckling the compression pole. | |
| $m$ | 48 | 432 | 46 | 362 | 24 | 4.0<br>3.9 | 3.9<br>3.8 | 3,800 | 4,870 | 0.55 | 0.50 | 0.069 | Casting bolted to the top end of the poles. Failed by the buckling of the compression pole. | See Fig. 12. |
| $n$ | 48 | — | 46 | — | 15 | — | — | 1,630 | — | 0.70 | — | — | Long casting. Failed by slipping on the pole. | Fig. 14. |
| $o$ | 48 | 433 | 46 | 363 | 24 | 3.8<br>3.8 | 3.5<br>4.0 | 3,600 | 5,136 | 0.80 | 0.73 | 0.087 | Poles fitted with bands and long oak block. Failed by buckling the compression pole. | Fig. 15A. |
| $o_1$ | 48 | 433 | 46 | 363 | 24 | 3.8<br>3.8 | 3.5<br>4.0 | 4,100 | 5,850 | 0.82 | 0.75 | 0.089 | Same again after refitting and notching arms. Failed by buckling. | Fig. 15B. |
| $p$ | 48 | 434 | 46 | 362 | 26 | 4.4<br>4.0 | 4.1<br>4.1 | 3,240 | 3,440 | 1.20 | 1.08 | 0.19 | Cast-iron cap. Failed by twisting the cap and buckling the compression pole. | Fig. 16. |
| $p_1$ | 48 | 434 | 46 | 362 | 26 | 4.4<br>4.0 | 4.1<br>4.1 | 3,300 | 3,504 | 0.85 | 0.76 | 0.13 | Same again after fitting oak chock. Broke tension pole at the chock at 1,540 lbs. sq in. of section. | Fig. 16. |
| $q$ | 48 | 385 | 46 | 215 | 24 | 4.0<br>4.0 | 4.1<br>3.9 | 5,500 | 5,760 | 0.80 | 0.72 | 0 16 | Heavy casting on end. no scarfing of poles. Failed by buckling. | Fig. 14 after refitting. |
| $e_2$ | 25 | 384 | 46 | 314 | 24 | 5.4<br>5.5 | 5.5<br>5.6 | 5,700 | 2,315 | 0.50 | 0.45 | 0.36 | Same as $e_1$ Failed by twisting oak chocks. | |
| $e_3$ | 25 | 384 | 46 | 314 | 24 | 5.4<br>5.5 | 5.5<br>5.6 | 8,960 | 3,640 | — | — | — | Same again after fitting new oak chocks. Failed in the housing. | |
| $e_4$ | 25 | 384 | 64 | 291 | 29 | 5.5<br>5.5 | 5.4<br>5.5 | Not broken<br>Max. load 3,900 | | 4.20 | 3.60 | 3.70 | Same as $e_1$. | "A" poles tested on the flat, or in the line of the wires. |
| $f_2$ | 25 | 385 | 64 | 295 | 26 | 4.6<br>4.7 | 4.4<br>4.4 | Not broken<br>Max. load 3,070 | | 11.70 | 10.20 | 4.90 | Same as $f$. | |

L = the length of the pole, in inches, measured from the ground level to the point of loading.

$L_o$ = the overall length, in inches.

G = the length of the pole, in inches, embedded in the ground.

T = the distance in inches, from the top of the pole to the point of loading in the actual pole tested. (In the tables this is taken as twenty-four inches throughout.)

S = the "spread" or "splay" of an "A" pole at the bottom, in inches.

K = the British Post-Office constant for comparing similar beams.

$= \frac{f}{6}$. Taken the same for both types of pole for convenience.

$f$ = the "modulus of rupture" for the pole in pounds per square inch.

$d$ = the elastic deflection, in inches, under a load of 1,000 pounds applied at the extreme end of a unit pole twelve inches long, one inch diameter, and of the same taper and material as the tested pole.

D = the elastic deflection, in inches, at the point of loading of the actual pole when tested.

$D_1$ = the deflection, in inches, at the extreme end of the actual pole tested.

From the above results we find that the mean value of $d$ for single poles is 8.4 inches, and for "A" poles tested on the flat 4.3 inches, thus the deflection of similar "A" poles when tested on the flat is practically one-half as great as that of a single pole when similarly loaded, which is quite what should be expected.

Some of the "A" poles were tested with imperfect housings, and others were of a purely experimental character, some of which proved failures; taking an average value for such poles as are likely to be used in practice and when properly held at the foot, *viz.*: *g*, *h*, *i*, *j*, *k*, *l*, *m*, *o*, $o_1$, $p$, $p_1$, *q*, $e_2$, it will be found that $d = 0.17$ inch, or one-fiftieth as much as that of a single pole. The highest value of $d$ for an "A" pole when properly held was 0.36 inch, or one-twenty-third; and the lowest value 0.069 inch, or one-one-hundred-and-twenty-second as much as that of a single pole. The great variation is probably due to slip in the top joint.

The curves given in Figs. 12 and 13 show clearly the manner in which the deflection and the slip of the top joint varied with the load.

As regards the relative strength of single and "A" poles, the mean value of K for the "A" type, as deduced from poles of practical design, *viz.*, *h*, *i*, *j*, *k*, *l*, *m*, *o*, $o_1$, is 5,748 pounds, or 4.42 times as great as the post-office value for a single pole. As already pointed out, the majority of poles failed through the buckling of the compression leg; this buckling was undoubtedly hastened by the initial sag in the poles due to their own weight, which, of course, will not occur in practice where the poles are set in a vertical position;

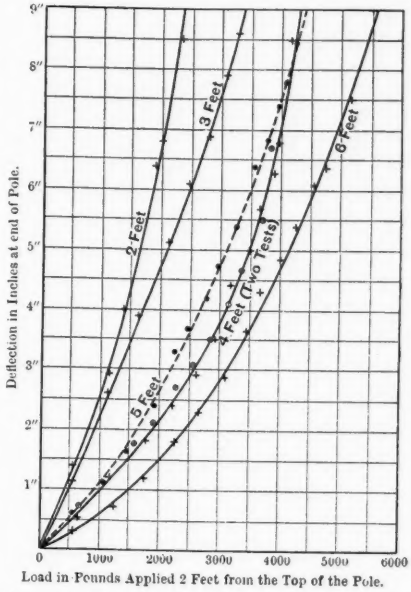



FIG. 12.—DIAGRAM SHOWING THE DEFLECTION OF THIRTY-SIX-FOOT "A" POLES WITH VARIOUS AMOUNTS OF SPREAD AT THE FEET.

hence it is considered safe to assume that "A" poles are about four and one-half times as strong as a single pole of the same size.

Finally, it is of interest to note the loads

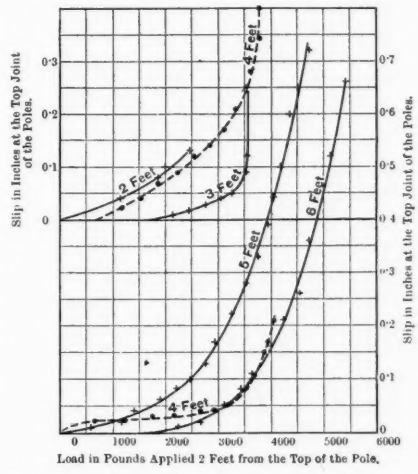



FIG. 13.—DIAGRAM SHOWING THE SHEAR OF SLIP IN THE TOP JOINT OF THIRTY-SIX-FOOT "A" POLES WITH VARIOUS AMOUNTS OF SPREAD AT THE FEET.

on the compression leg of the poles when buckling took place, as given in Table III.

TABLE III.

| Index. | Splay in Inches. | Force in Tons acting on the Compression Pole when Buckling Occurred. Experiment. | Calculated. |
|---|---|---|---|
| *i* | 48 | 14.4 | 12.8 |
| *j* | 48 | 13.2 | 12.6 |
| *k* | 60 | 14.8 | 13.0 |
| *l* | 72 | 12.2 | 12.6 |
| *m* | 48 | 12.7 | 13.4 |
| *o* | 48 | 12.0 | 11.9 |
| $o_1$ | 48 | 13.7 | 11.9 |
| *q* | 48 | 16.0 | 18.0 |

## The Annual Meeting of the National Electrical Trades Association.

The eighth annual meeting of the National Electrical Trades Association was held in the Great Northern Hotel, Chicago, Ill., Thursday, June 20, 1907.

There were present representatives from the membership in Boston, New York, Philadelphia, San Francisco and Chicago associations. The membership of these combined organizations now totals 380, and the year just past has been one of phenomenal success.

The association, as it is generally known, is organized for the cooperative exchange of credit information. The manufacturers and jobbers composing its membership report to the central office the names of customers who are tardy in making their payments; if, after notices from the association, such customers do not pay the claims for which they are reported, the information is distributed among practically every manufacturer and jobber in the electrical and kindred lines in every state in the Union.

Incidentally the forms of the association thus employed enforce collection where all other means fail, and since the establishment of the national association there has been collected more than $2,500,000 by this agency.

The officers elected for the ensuing year were as follows:

President—John Dale, the Dale Company, New York.

Vice-president—Chas. M. Wilkins, Partrick, Carter & Wilkins, Philadelphia.

Secretary and general counsel—Frederic P. Vose, Marquette Building, Chicago.

The next meeting will be convened in Philadelphia.

## The Technical Publicity Association.

The subject of the June meeting of the Technical Publicity Association was "Advertising in Reference Books." The paper of the evening which formed the basis of the general discussion was read by James J. Degnan, editor of *Henrick's Commercial Register*.

The subject for discussion at the first fall meeting of the association, which will be held in September, will probably be "The Mailing List," according to the plan outlined by F. F. Coleman, of the Lidgerwood Manufacturing Company.

The following new members were elected: William H. Kritzer, manager publicity department, Traylor Engineering Company; and W. S. McGowan, eastern sales manager, American Brake Shoe and Foundry Company.

# American Institute of Electrical Engineers.

**Twenty-Fourth Annual Convention, Niagara Falls, N. Y., June 25th to June 28th, 1907.**

THE twenty-fourth annual convention of the American Institute of Electrical Engineers was opened at Niagara Falls, on June 25th, by President Samuel Sheldon. The Institute was welcomed to the city by Mayor A. C. Douglas. The mayor was thanked on behalf of the Institute by President Sheldon, who then delivered the annual presidential address.

A brief report of this meeting, as well as of the Tuesday evening session, was given in the ELECTRICAL REVIEW, June 29. A more complete report of the discussion is given below.

Dr. A. E. Kennelly and E. R. Shepard presented a paper on "The Heating of Copper Wires by Electric Currents," which was read by title, the authors being absent.

This describes a series of experiments on the heating of copper conductors, giving in detail the method employed for measuring the resistance, and for determining the heat developed in the conductor. The theory of the temperature elevation of an active conductor cooled entirely by thermo conduction is developed, and the results of a large number of experiments are given.

Following this, Henry W. Fisher read a paper entitled "Power-Factor, Alternating-Current Inductive Capacity, Chemical and Other Tests of Rubber-Covered Wires of Different Manufacturers."

This describes the results of a large number of tests made on various makes of rubber-covered wire. Specifications for this kind of wire usually are framed so as to require an insulation consisting of thirty per cent pure para, yet so as to give the manufacturer some latitude in the use of other ingredients. One object of the test was to determine the relative qualities of these different makes of rubber insulations, and to see if measurement of the power-factor would not give some insight into this.

A method of measuring power-factor developed by Dr. E. B. Rosa of the Bureau of Standards, Washington, was used. A special form of bridge having non-inductive resistances with minimum inductive capacity was constructed. A vibration galvanometer was used, in connection with a motor-generator the speed of which was kept constant by an electrically driven tuning-fork. By careful adjustment of both the tuning-fork and galvanometer, the two could be brought into synchronism, when the latter becomes a most sensitive instrument for detecting alternating currents. As the galvanometer needle responds only to the fundamental period of the alternating current, it is not necessary in such tests to employ a sine wave electromotive force. The method employed was based upon the fact that a cable or condenser, the absorption and leakage of which is not zero, is equivalent to a cable or condenser with zero absorption in series with a suitable resistance.

The sample of cable was inserted in one arm of the bridge and the latter adjusted until a balance was obtained. The reading then gives, by simple computation, the power-factor of the cable. Knowing this it is easy to determine the energy loss of the insulation. The samples tested were 210 feet long, placed in a metallic tank filled with a salt solution. Curves showing the results of these tests, continuing over a period of fifty-two days, are given.

The breakdown potential tests were made on four-foot samples of core cable, and samples were also reserved for chemical analysis.

The general results show that the resistance of the insulation does not depend upon the per cent of rubber, certain insulations having less rubber than others showing a higher resistance. It is found also that the breakdown voltage was not proportional to the thickness of the rubber. The energy loss as determined by measuring the power-factor seems to be a good indication of the value of the insulation. Taking all together, the tests show that the addition of certain materials to a rubber insulating compound containing thirty per cent para rubber, which upon chemical analysis showed a higher per cent of extractive matter, results in a much better quality of rubber-insulating material than one having an equal proportion of para but showing less extractive matter.

Dr. C. P. Steinmetz said that the method of testing cable described in the paper might lead to an advance in the investigation of cables. There is, however, another factor to be considered—that of deterioration—and for this reason it is not desirable to judge cable merely by the dielectric energy loss. However, this loss may have some effect upon the life of the cable, although the latter does not necessarily follow the energy loss. Unfortunately we know but little about this subject. The hysteresis loss alone would be less if the temperature of the insulation were kept low. It seems, however, to be a conversion of this energy of the chemical action which is carried on the dielectric hysteresis, or the gases occluded in it. If it were possible to separate this chemical effect from the whole, some indication of the life of the cable might be obtained. However, it is not known that the chemical action would be uniform throughout the insulation.

Dr. Steinmetz said that the power-factor would vary with the supply voltage, and should therefore be measured at the operating voltages. He pointed out that the energy loss of a condenser is more properly represented by shunting an ideal condenser than by placing a resistance in series with it.

H. G. Stott thought that the author had started from a wrong point of view. What should have been done was to vary one component of the insulating material at a time, making these up in small quantities for testing. In this way the effect of each element could be traced. In the tests described, there were too many variables to enable any satisfactory conclusion to be drawn. He said that he found he could obtain the same insulation characteristics when using reclaimed rubber as when employing thirty per cent para. He pointed out also that the chemical analysis of rubber is difficult, chemists not yet being satisfied on this point.

In reply Mr. Fisher said that the samples which he had tested were intended for low voltages, and therefore the work had been done under operating potentials. It was expected to extend investigation to higher tension cables. The method employed was not his own, but he had taken it as correct.

Replying to this, Dr. Steinmetz said that we as yet know too little about the static field, but by analogy with the magnetic field the resistance should be placed in shunt. However, as an approximation the series arrangement was allowable.

Following this, Professor Morgan Brooks presented a paper entitled "Interaction of Synchronous Machines."

Professor Brooks has developed a new

circle diagram for effecting graphical solutions of synchronous machine problems. He shows that by assuming a constant terminal voltage at the motor or a constant generated electromotive force, this constant quantity can be taken as the chord of a circle whose centre may be found by determining the angle of lag due simply to the impedance of the machine circuit. By proper construction of the diagram, conditions representing constant power for the motor, constant output for the generator and other such conditions are easily complied with. To simplify matters, but one digram is used for motor and generator and for two generators in parallel, it being simpler to

DR. SAMUEL SHELDON, PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 1906-1907.

consider one diagram reversed, rather than to construct a second diagram.

The discussion was opened by E. J. Berg, who said that a diagram based merely on theoretical conditions was not sufficient to enable the performance of a machine to be predicted. A machine might have the same impedance but would not give the same performance.

Dr. C. P. Steinmetz said that such diagrams were ideal and good for illustrations, but the results which they gave could not be produced experimentally. Magnet saturation is a disturbing factor, and as this effect is asymmetrical, it throws out all diagrams and calculations.

In reply Professor Brooks said that the diagram was not intended to take care of all idiosyncrasies of machines, but was for use when the actual condition approximated the ideal, and serve to illustrate the operation of the machines. As proposed, it is much simpler than those heretofore in use.

TUESDAY EVENING SESSION.

The Tuesday evening session was called to order by the president at 8.30, and Chairman T. C. Martin, of the building committee, was heard regarding the progress which had been made in collecting subscriptions for the Institute's share of the ground for the Engineering Societies Building. Nearly $164,000 has been raised, but there is still $21,000 to be secured. An earnest plea was made to all those who have not yet contributed, to do whatever they could toward wiping out this debt.

The first paper of the evening was by E. E. F. Creighton, entitled "Protective Apparatus Engineering." As there were two other papers upon the same general topic, one by Percy H. Thomas, entitled "Practical Testing of Commercial Lightning Arresters," and by N. J. Neall, on "A Proposed Lightning-Arrester Test," these were all read together.

Mr. Creighton gives a general review of present knowledge regarding lightning protection. He considered the effect of location of circuits, the factors of damaged insulation, trouble inspection and the difficulties of determining just what causes the failure, and he gives a preliminary outline of a standardization recommendation. He believes that before attempting to reach standardization rules it is first necessary to select names for the apparatus and the general terminology; second, the nature of the lightning as far as known and the strain which must be relieved by the protection apparatus wanted must be known; a third consideration is the nature and characteristics of the insulation to be protected; a fourth is the characteristic of the protection apparatus itself; a fifth, the nature of the tests to be used to demonstrate the effectiveness of the protective apparatus. Mr. Creighton gives a list of terms with his definitions. He then takes up the consideration of the nature of the lightning; referring to previous Institute discussions. On the subject of frequency he distinguishes factors; the frequency of the generator; the frequency of the main circuit; frequency of the line circuit; miscellaneous oscillations and forced oscillations from an external source. He points out that lightning oscillations last for only a short duration, the one exception being continuous surges set up on one line from a parallel line. The rate at which the oscillation dies out is important. Here there are two points to be considered: the time required for the voltage of the disturbance to fall to the safe potential, that is the potential which the insulation will stand for a short time; second, the time required to fall to the line potential or the potential which it will stand indefinitely.

Regarding the nature and characteristic of the insulation to be protected, a good deal of information is now available from published tests, but there is a lack of data dealing with tests by means of transiently applied potentials; such tests bring out properties in the insulated material not shown by continued voltage tests. This difference results from the dielectric spark lag and the property of self-repair.

Regarding the characteristic of light-

MR. HENRY GORDON STOTT, PRESIDENT AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, 1907-1908.

ning arresters, the following factors should be observed: the effect upon the equivalent needle gap, and the natural frequency of the oscillation; the rate of discharge of the arrester; the quantity of discharge; the nature of the dynamic current suppressing device; the endurance of the arrester and the spark lag, if any.

Mr. Creighton then offered several tests to supplement those described in previous papers presented to the Institute in May, 1906. These are the tests of static dischargers, of equivalent needle gap of common frequency and disruptive stroke tests; Tesla transformer test; half-wave test, and endurance test.

Mr. Thomas in his paper states that tests of lightning arresters should be made to determine the condition of individual arresters, the effectiveness of a particular design, and the characteristics of different types. Tests should also be made to cover auxiliary apparatus. The features of an arrester apparatus most susceptible of satisfactory tests are the initial break-

down voltage; the static equivalent during discharge; the circuit-opening power; the insulation strain; the ability to stand repeated discharges; choking power; insulation strain on the choke-coil and the equivalent apparatus.

The actual measurement of a breakdown voltage should be made at normal frequency. Although it is difficult to devise an absolute test of general character to determine the equivalent needle gap, comparative tests between the arresters may be advantageous. Tests of the different type arresters to demonstrate this characteristic are described in detail.

It is difficult to determine the circuit-opening power of an arrester, but it may often be determined from general consideration where an arrester will be non-arcing, in which case a test will be unnecessary. The author concludes his paper with certain suggestions, one being that the insulation strain of lightning-arrester design should be able to stand the abrupt application of a condenser of at least 0.01 microfarad capacity, charged to a potential three times normal arrester potential and not less than 50,000 volts, without sparking between parts or to the ground. Breakdown voltage of normal frequency should be determined in all cases, and where general considerations are not sufficient to determine the amount of impedance offered to a discharge, comparative tests between arresters may be made by noting the needle-gap equivalent.

Where general considerations are not sufficient to determine the non-arcing power of an arrester, a test may be made by passing sparks over the arrester connected to a source of electromotive force of sufficient power to supply all the current which the arrester will take. Endurance tests may be made in the same manner, the discharges being repeated at intervals of some seconds, and in addition to the behavior during these tests the general performance of the arrester should be carefully watched.

The author also gives three appendices; one dealing with the question of testing with high frequency; the second describing certain limitations and the severity and force of discharge from common transmission lines; and the third, a bibliography of lightning-arrester papers printed in the Institute's transactions.

Mr. Neall describes a test of lightning arresters based upon the methods of obtaining high-potential, high-frequency oscillations employed in wireless telegraphy by a suitable arrangement of condensers and induction coils, and by connecting this circuit at an intermediate point to a multi-gap or similar arrester, discharges are caused to take place across the arrester. The advantage of this method lies in its readiness of application, its simplicity, and the fact that the spark does not coat the cylinders or gap with metallic fumes. Adjustment may be varied to suit any requirement, and is thought to offer a ready means for determining the effectiveness of any system of lightning arresters after installation.

Dr. Steinmetz in opening the discussion pointed out the many difficulties met in making lightning-arrester tests. It is frequently impossible to conduct these, as suitable apparatus is not available. Moreover, it was asked, should the test be made on an individual sample or on the entire lot purchased, as frequently there is nothing left of the arrester after the test has been made. Mr. Neall's paper, although it shows how such tests may be made in practice, seems rather dangerous to the system itself. It, however, gives an endurance test of the arrester. Most arresters are able to cope with single surges, but will fail under continuous strain. Such conditions call for arresters of the aluminum-cell type. The tests described have also to be modified for the study of arresters of aluminum and the water-resistance type.

Mr. Creighton said that he agreed in general with the recommendations made by Mr. Thomas, but thought that laboratory tests should be made as severe as possible. He thought that Mr. Neall's test corresponded to the half-wave test which he had described.

Mr. Thomas said that the Institute should be very careful in approving any rules dealing with lightning-arrester testing; such tests as should be adopted are those applicable by any engineer. We know too little regarding the aluminum arrester as yet to decide upon its real value or to specify any test for it. Regarding Mr. Neall's proposed test, it is ingenious, but it is not always desirable to make an endurance test. Referring to the definitions proposed by Mr. Creighton he said that there are already too many terms in use, and it is not desirable to complicate the subject by defining any more.

W. S. Lee, Jr., said that any test made should be carried out on the ground after installation, and that these should be applied periodically in order to determine the condition of the arrester on the system.

Mr. Neall said that there was no difficulty in applying his test and obtaining satisfactory discharges across the arrester and that it was a simple matter by means of a suitable switch to apply his test for a short time only. An endurance test need not always be made. He agreed with Mr. Thomas that we should be cautious in adopting more terms. What is wanted now is practical results, and not more theoretical discussions.

A paper by Louis Cohen, entitled "Inductive Disturbances in Telephone Lines," was, in the absence of the author, presented by title and not discussed.

The induction taking place in telephone lines is both electromagnetic and electrostatic. In 1891 J. J. Carty, in a classical paper before the American Institute of Electrical Engineers, discussed a series of experiments which he had conducted to determine the relative importance of these two effects, and his conclusions were that the electromagnetic effect is entirely negligible as compared with the other. The author endeavors to show here that although these conclusions were warranted by the experiments which were made, that they can not be applied to different conditions; that the relative importance of the two effects is a function of the length of line, and that with longer lines the electromagnetic effect would have become important, and even more important than the electrostatic induction.

WEDNESDAY MORNING SESSION.

Wednesday morning session was opened at 9.45 by President Sheldon, and the following three papers on kindred topics were read and discussed together: "Choke-Coils *versus* Extra Insulation on the End-Winding of Transformer," by S. M. Kintner; "Protection of the Internal Insulation of a Static Transformer against High-Frequency Strains," by W. S. Moody; "Notes on Transformer Testing," by H. W. Tobey.

This paper describes the methods employed at present in testing transformers. The tests made include conversion, polarity, resistance, copper loss, core loss and exciting current regulation, high potential, high voltage and temperature rise. The term "high potential" designates a test applied between primary and secondary windings and the iron. The high-voltage test is one applied across terminals of the same winding. The first tests the strength of insulating barriers, the second the insulation between turns and layers. The conversion test is most satisfactorily made by means of a standard transformer. The relative positions of primary and secondary terminals are determined by the polarity test. The drop of poten-

tial method is used for the resistance and copper loss tests. It is pointed out that in determining the core loss and exciting current, the value found varies considerably with the wave shape of the applied potential; hence this should always be given or referred to a standard, preferably the sine wave. In testing regulation it is now customary to determine this by means of an impedance test made with one of the windings short-circuited. For the high-potential test it is desirable to introduce a high resistance in series; but when done, this may change the effective sparking distance of the testing transformer, and should be allowed for. It is pointed out that the dielectric strength of materials falls considerably with the length of the test. A curve was shown of a particular sample, in which this effect was pronounced, the dielectric strength falling from eighty kilovolts to thirty-three kilovolts in one hour.

The discussion was opened by A. H. Pikler who said that transformer designs should always tend towards simplicity. It is not desirable to use part of the transformer as a protection, as it complicates the device, and both the transformer itself and the protective characteristic of the system suffers. He advocated the use of choke-coils outside of the transformer case. However, it was also desirable to use some extra insulation on the transformer-end coils.

K. C. Randall, of Pittsburg, Pa., said that extra insulation should be used on the end turns, but he did not believe in eliminating the choke-coil: however, the latter might be made smaller.

D. B. Rushmore, of Schenectady, N. Y., said that while resonance does not occur often, it may, and the choke-coil is apt to make matters much worse, as it causes a rise of potential which is dangerous. Under other conditions, however, choke-coils are desirable.

P. M. Lincoln, of Pittsburg, Pa., believes that choke-coils are logical devices and of value. There is no continuous voltages between their turns as is through the transformer winding, and they are therefore more effective than the end turns of the transformer. If the coils be eliminated the extra insulation should be extended to nearly the entire coil of the transformer.

J. W. Fraser said that the size of the transformer had something to do with the question. Where there are many coils to a substation the cost increases. For this reason it has been found desirable to use smaller coils for protecting transformers in substations than were adopted for the generating station. An extra transformer to take the place of a damaged one is cheaper than installing a complete set of the larger coils.

W. N. Smith said that it is desirable to simplify the transformer as much as possible. It is also desirable to carry in stock transformer coils which can be easily replaced when a transformer is damaged. It is impossible to devise standard choke-coils, but the power company should use judgment in selecting them. The position of the coil depends upon the apparatus to be protected, and if placed within the transformer will not protect anything beyond that.

C. W. Stone said that coils may be used to prevent disturbances from entering terminal cables, and in such cases should be placed on the outside end of the cable and not in the transformer case.

Mr. Creighton said that choke-coils are a disadvantage, particularly when lightning originates within the station; in such cases lightning arresters should be placed on each side of the coil to prevent the magnification of potential due to the coil on the other side. He described an instance in which a breakdown of a transformer occurred on the far side of the coil, caused by a potential, which is evidently greater than that which would have discharged the arrester, although the original disturbance had not caused any discharge.

William McClellan said that until we know how these potential rises penetrate into the transformer, and how we should let them down easily, we should use a coil or some device to prevent them from entering the station.

Morgan Brooks called attention to the change in inductance of a coil or winding due to the saturation of the iron circuit and described some experiments which had been made upon this subject. He had found that the rise of the potential in the case of a transformer, due to suddenly closing the primary, depended upon the phase of the electromotive force at the moment of closing, but not upon the residual magnetization of the iron.

W. S. Lee said that he had found the greatest trouble due to the burning off of the terminals of the transformer and choke-coils.

R. P. Jackson said that disturbances will penetrate into the transformer. He thinks it is better to measure this penetration in terms of the inductance than in feet of wire. Usually 0.04 henry in a coil will keep out the surges. This value is large for a small transformer, and will let the disturbance penetrate. It is necessary only to insulate enough of the end turns to provide this inductance, but he doubts if practical conditions are often such that the coils are objectionable. When the disturbing frequency is high enough to jump the coil it will jump across the transformer turn also.

C. P. Steinmetz said that as the coil is intended to prevent high potentials from entering the station apparatus, it should be placed next to the lightning arrester, hence it can not always be placed in the transformer case, and if there be any auxiliary apparatus, such as switches and bus-bars to be protected, the transformer itself can not be used. It is, however, convenient to place the coil when used, in the transformer case if there are no auxiliaries. The insulation of such coils is difficult unless it be air. It may be desirable to place them on a pole outside the station. If this be done it is necessary to guard against trouble arising within the station, and then extra insulation on the end turn becomes desirable. Referring to Mr. Creighton's trouble he said that the inductance of the transformer in series with the capacity of the station wires gave conditions which seemed to give a frequency of about 300,000, which would be in the same order as lightning. The possibility of such conditions arising should be kept in view. To avoid this the length of wire between the coil and transformer should be as short as possible, and the inductance as small as possible. However, a coil is desirable between the line of the station, as it decreases the steepness of the front of an approach surge.

R. D. Mershon does not care for choke-coils unless they are small, and placed outside the station. He said it is easy to arrange a transformer so that the same end coils may be used for both series and parallel connection of the coils. We are as yet ignorant about the frequency existing in lightning disturbances. In making test of transformer he had found it difficult to maintain the testing current constant. The insulation test should be made after the transformer had been put in place. He wanted to know how engineers are to specify the method and amount of end-turn insulation.

D. B. Rushmore approved of the use of a coil. He pointed out that a transformer will stand momentarily three and one-half times the normal potential, while

line insulators will not. The question is how large a coil should be used.

H. W. Buck said that conditions are too complicated in practice for calculations to be made concerning them, or for the conditions to be reproduced in the laboratory. In his opinion we can not say whether coils are good or bad.

In closing the discussion, Mr. Kintner said that placing the coil within the transformer case simplifies matters, but it is not altogether desirable. He described an experiment similar to that cited by Mr. Creighton, but said that he did not get any such effect.

Mr. Moody suggested making up end-turns of the transformer which are to be tested to stand twenty-five per cent of the voltage.

Mr. Tobey said that he had no difficulty in maintaining his testing current constant, as he used the exciter for furnishing the current, running the latter at normal potential and reducing the current by means of a resistance. He believes that the high-potential should be made before the resistance test.

D. R. Scholes presented a paper entitled "Transmission Line Towers and Economic Spans."

The author works out a mathematical discussion of the wind pressure, external loads and ability to sustain weight of the pole-line system. A hypothetical installation of a three-phase, alternating-current system is also worked out, showing the application of the formula which the author derives.

This was followed by a paper presented by Norman Rowe, entitled "Lightning Rods and Grounded Cables as a Means of Protecting Transmission Lines Against Lightning," which, in the absence of the author, was read by R. D. Mershon.

This paper gives a summary of the lightning trouble during the years 1904, 1905 and 1906 on a steel tower, long-span transmission line in the states of Michoacan and Guanajuato, Mexico. The experience of the last three seasons permits the writer to offer the following suggestions: 1—insulators should not be disposed upon poles or towers so that they will be in the path of bolts of lightning coming to ground by the supporting structure; 2—a grounded cable strung above the transmission wires at the highest point of the tower is certainly more effective than lightning rods; 3—lightning arresters for discharging the line in case very high voltages are present on the wires would be of some value if located along the line at frequent intervals; 4—on steel construction an insulator should be used that has a high emergency of safety against puncture and arcing over.

In the discussion of these papers, which was participated in by William Hoopes, P. H. Thomas, W. S. Lee, Jr., F. B. H. Paine, C. W. Ricker, N. J. Neall, J. W. Frazer and R. D. Mershon, it was pointed out that Mr. Scholes's solution of the economic span for transmission lines can not be followed exactly because it is impossible to include in it local conditions.

Mr. Lee said that in irregular countries it is often desirable to place short spans on the hill tops so as to enable the valleys to be crossed in a single span.

Opinions differed considerably regarding the best method of protecting overhead lines. Mr. Lee said that his company, in South Carolina, had been using an overhead ground wire, which seemed to give a good deal of protection. Before installing this, poles had been shattered by lightning. After putting up the line no trouble had been encountered. In one case there was trouble, but this was due to the method by which the ground wire had been installed, the brackets holding it not being rigid enough.

Mr. Ricker said experience with lines in Ohio, where lightning is frequent, but not particularly severe, had led to the removal of the iron brackets to the cross-arms, and to the adoption of a longer wooden pin. This stopped breakage of insulators almost entirely.

Mr. Mershon thought that Mr. Scholes's solution of the proper span omitted certain factors, but it did give some idea of the approximate span to be adopted, which may be modified to meet local conditions. Regarding the use of ground wires, he did not value them at all. On the transmission line of the Niagara, Lockport & Ontario Power Company no ground wire is employed, but horn lightning arresters are placed on the pole top, one side of the arrester always being connected to the top wire. These arresters are 2,200 feet apart, set with a six-inch gap, but it is probable that the gap will be reduced about four and one-half inches. He is inclined to believe, from his experience, that lightning does not travel along the line, as he said insulators broke within 500 feet of an arrester. He found that seventy-five per cent of lightning troubles happen to the top wire; hence the method of installing arresters. The wires are not transposed; otherwise the discharge might lead to a short-circuit. The arresters take care of eighty-six per cent of the lightning disturbances.

Mr. Scholes said that it is impossible in a paper to include every possible condition, and certain assumptions must be adopted. He pointed out that more attention has been directed to the particular application of his method made in his paper, to the general solution itself. He thought that usually assumptions could be made, which, by means of his method, would lead to a very close estimate of the most economical span. To the criticism that it was not safe to estimate the cost of towers at the fixed price per pound, independent of the height, he pointed out that frequently bids must be submitted on this basis.

WEDNESDAY EVENING SESSION.

The Wednesday evening session was called to order at 8.30 by President Sheldon, and a telegram from Past-President B. J. Arnold was read. This expressed Mr. Arnold's regret at not being able to attend the convention as he had expected.

Five papers were then read and discussed together. These were: "The Transmission Plant of the Niagara, Lockport & Ontario Power Company," by R. D. Mershon, read by P. M. Lincoln in the absence of the author; "Location of Broken Insulators and Other Transmission Line Troubles," by L. C. Nicholson; "New Type of Insulator for High-Tension Transmission Lines," by E. M. Hewlett; "Some New Methods in High-Tension Line Construction," by H. W. Buck; "Switchboard Practice for Voltages of 60,000 and Upward," by S. Q. Hayes.

Mr. Mershon's paper describes and illustrates the transmission lines of a purely distributing company. Power is bought from the Ontario Power Company on the Canadian side of the river and carried across the Gorge by two lines, and thence over transmission lines to Lockport, Buffalo, Rochester and Syracuse. The transmission voltage is 60,000, and the conductors are of aluminum cable carried on iron towers, the lines being in duplicate. The installation which is now in operation is receiving 30,000 horse-power. The lines are capable of transmitting varying amounts of power, according to the points reached, from 30,000 to 10,000 horse-power. The lines are protected by horn arresters placed on the poles, as already mentioned in the discussion of a preceding paper. At the substations high-tension bus-bars and disconnecting switches are erected out of doors on poles. There are, in addition, oil switches for controlling the station connections. The arresters are also placed on poles.

Mr. Nicholson makes a careful analysis of transmission-line troubles and their detection. When long lines are sectionalized

by disconnecting switches spaced at regular intervals, it is possible by successive applications of voltage to section after section to determine the particular section which contains the fault, and then to locate the exact point of failure by patrolling a considerable length of line. This process is tedious on account of the necessity of manipulating the line switches upon telephone advice from the generating station, and by reason of the time required to patrol the particular section containing the fault. The author describes several of the well-known tests for locating faults in a transmission line, and criticizes all of these. A simple scheme of connections involving the manipulation of a few hook switches has been employed for locating faults upon a long-distance, high-voltage circuit, and it has been found possible to locate quickly and accurately any fault seriously interfering with operation. The method consists in supplying current from a generator and transformer to the fault to earth through a divided circuit or a loop formed by joining two line conductors together at both ends, one of the wires so connected containing the broken insulator to be located. The total current supplied divides quantitatively between the branches of the loop in a proportion depending upon the ratio of the two impedances to the fault, which ratio is determined by, and therefore is determinative of, the location of the fault. Indicating ammeters and integrating wattmeters connected in the two branches of the loop by means of proper transformers show the current of power supplied through the respective conductors. After describing in detail the application of this method, the author states that the test is subject to the following restrictions: When several faults are on a single wire, they must be located in reverse order of their insulating values, and must be repaired in the order located. When all three wires are in trouble, the one having the highest insulation can not be tested until one of the others is repaired. If two complete grounds a considerable distance apart occur on a single wire, the localization will be in serious error.

Mr. Hewlett's paper described a new type of insulator designated as the "link" insulator. This is made up in sections, and is of two types—the suspension and the strain insulator. The former are shaped somewhat like the lid of a cooking utensil, perforated by two interlinked openings, by means of which two or more sections, as desired, may be linked together by cables. The structure is such that if a section be broken, the two cables will engage and the line will not drop. The strain insulators are constructed so that the water will drain off centrally, and not from the edges, so as to keep one side of the insulator dry, no matter what the direction of the wind. The advantages of these insulators are that a broken section is easily replaced, and that the full value of each section is obtained.

Mr. Buck's paper describes a method of construction designed to employ the link insulator. The lines are suspended by metal clamps, and as many insulator sections as may be required from beams carried on the transmission towers. The lines thus hang below the point of suspension. Where strains are to be taken up, the strain insulators are employed, and electrical connection made around the insulator by a jumper.

The paper by Mr. Hayes describes in some detail the types of switchboard which have been developed for high-voltage work. The subject is taken up under four heads—the general scheme of connections, necessary equipment, design as followed at present, and future design. Under the latter head it is pointed out that a possible development of the future will be the placing of all the high-tension apparatus out of doors in sections, where the climate is not too severe. Switches are now available which can be placed on poles and operated over a distance.

In the discussion of these papers, J. B. Taylor said that few plants were in a position to adopt the scheme described by Mr. Nicholson, although it might be employed where the company was fortunate enough to have a man competent and willing to undertake the work. Some question was raised also why the reactance of the two sections of the loop was of the same ratio as the resistances. He suggested that a simpler method would be to send a current over the faulty line, and measure the voltage induced in a parallel wire. This would be proportional to the distance of the fault from the station.

D. B. Rushmore said that in all commercial plants it is essential that continuity be preserved, and this did not seem to be insured when the duplicate transmission lines entered a town from different points, as is true of certain of the Niagara, Lockport & Ontario Power Company's lines. He thought there was no objection to carrying two or more lines on a single tower. It had been shown that a wooden pole lasts but eight years, and he raised the question, what was to be done when it was found necessary to replace the poles. This difficulty seemed to him to bar out the use of such poles. He thought that the type of insulator described by Mr. Hewlett might make it possible to operate above 60,000 volts.

William McClellan thought that a considerable advantage about the insulator described by Mr. Hewlett was the doing away with the cementing process for joining sections, and he drew attention to the tendency to locate as much as possible of the high-potential apparatus out of doors, rather than in the station. When this is done, however, the pole switches should be such as can be operated from the ground. It is barbarous to send a man up a pole on a bad night to open such switches.

Others who took part in the discussion were P. M. Lincoln, F. B. H. Paine and W. N. Smith.

In reply to the discussion, Mr. Nicholson said that Mr. Taylor's plan has been tried, but the results were not encouraging, as parallel lines had upset the measurements, inducing voltages in the test line. Such a scheme also called for special instruments.

Mr. Hewlett, in answer to a question, said that the cost of the insulators which he had described was about $1.50 a disc. He did not think there would be as much difficulty due to the formation of ice and sleet as with the older type of insulator. He said that in testing these insulators it had been found that the distribution obtained across the different sections was not uniform, but became more so as the voltage was increased. With 100,000 volts applied, the first of four sections took 35,000, but as the voltage was raised up to 380,000, there was not so much difference. There would be no trouble due to the swinging of the apparatus with the apparatus proposed, and line was easy to erect. The insulator swings as a whole, and there is no chafing at the point of suspension.

Mr. Buck said that repair work with the scheme which he had proposed could be carried on provided the lines on which work was being done were grounded. These wires are separated by twenty feet or more, and there should be no risk to the workmen.

(*To be concluded.*)

## ELECTRICAL NOTES FROM EUROPE.

*(From Our Special Correspondent.)*

That electric traction is soon to be introduced on a large scale upon the government railway lines in Sweden is evidenced by the fact that electric trains will soon be running for regular service upon the section of railroad lying between Stockholm and Jarfoa. The results of the operation of the new section will be made the basis for applying the same or similar systems upon other and no doubt longer sections of railroad in Sweden. Hydraulic power is abundant in many parts of the country, and it will furnish all the current which is needed for the lines. Seeing that at present the government is obliged to spend large sums for importing coal from other countries, the use of hydraulic power will mean a great economy, so that the matter is now being actively taken up. Two types of train will be run upon the new section, one of these using an electric locomotive and a number of standard railroad cars, and the other made up of a motor car and trailers.

---

A new power plant is in erection in Sweden which will rank among the largest of the Continent, and the Tröllhattan fall is utilized in this case. It is expected to secure no less than 75,000 horse-power from the present hydraulic work, and a good part of this will go to operate a number of turbine-alternator groups which will soon be erected in the plant. The units will have a capacity of 10,000 horse-power each. A power line will run from the turbine plant for a distance of forty-six miles to the city of Gothenburg, where the current is to be used upon the city mains. An electric furnace plant for the treatment of ore will also use a large amount of current, and the ore will be brought from the mines which lie in the northern part of the country by a specially built electric railroad.

---

The large porcelain works at Hemsdorf, Germany, has lately installed a special plant for testing high-tension insulators. Using a type of raising transformer, they are able to secure a voltage of 200,000 volts. These transformers were built by the Siemens-Schuckert firm, and are provided with safety spark-gaps. Current to the primary is supplied at eighty volts, and this is taken from a rotary converter which works upon 110 volts direct current. The insulators are tested a number of times, and under different conditions of air and moisture, and they appear to be able to stand 200,000 volts without difficulty.

It appears that electric traction is to be applied upon the suburban lines of Paris which start from the St. Lazare Depot and run through the western district. According to the present project, the arrangement of the tracks leading from the depot is to be changed considerably. What is desired in this case is to make the suburban lines independent of the through traffic, in which event it will be much easier to operate both the through and local service. At present there is some difficult in carrying this out properly, especially as regards the suburban stations which lie quite near the city. One of the pairs of tracks will no doubt be equipped with the third-rail system such as is used with success in the Orleans lines for the suburbs.

---

Owing to the increase which has been made in the hydraulic plant at Kubel, Switzerland, it is now taking rank among the foremost in the country. The station lies in the northeastern part of the county, near St. Gall. At present its capacity reaches 7,200 horse-power, but by the early part of next year there will be a number of new turbine-alternator sets installed in the plant, which will bring the total up to 10,000 horse-power. As a reserve, there will be a steam engine plant which is to have a capacity of 3,500 horse-power. After the period just mentioned, it is proposed to still further increase the plant, seeing that a large amount of water power is available for the purpose. The Monäsch mountain torrent is to be used here, but it will be necessary to construct a large reservoir or artificial lake in order to equalize the supply for the station. A dam of iron construction forms part of the present project, and the capacity of the reservoir will be about four million cubic metres. This part of the hydraulic work is estimated to cost $400,000.

---

The new electric light and tramway system of Damascus has been recently put in operation. A hydraulic plant, erected twenty-four miles distant, at El Tequieh, supplies power. At this point are located the Barada falls, which supply the city with water and also serve to operate a hydraulic station of some size which has recently been erected. At present the turbine-alternator units set up in the plant have a combined capacity of 1,200 horse-power. The three-phase system is employed. Within the city there is a substation which delivers current for the mains at 500 volts, three-phase, and also furnishes direct current at the same voltage. As regards the tramway lines, they run within the city and also to the suburbs. At present there are but four miles of tramway in operation, but this is soon to be increased. The public lighting is well carried out, and arc lamps are used quite extensively in the streets.

---

Mercury vapor lamps are coming into use on the Continent and are found of especial benefit in some kinds of factories where there is a damp atmosphere, or where vapors of different kinds are abundant. In such cases the lamps are fixed to the ceiling and the light reflected downward. A factory of considerable size in Vienna is equipped with mercury vapor lamps in this way and the result proved to be very satisfactory. In this case the establishment has a surface of 650 square metres and the ceiling is 4.2 metres high. There are twelve lamps of the Cooper Hewitt pattern installed overhead and held by bronze fittings to the ceiling. The lamps are operated upon direct current at 220 volts, and measure 115 centimeters in length. According to a series of tests, which were made not long since, the light which is reflected downward, taking an angle of forty-five degrees below the horizontal, is found to be 955 candle-power. At an angle of sixty degrees it is 1,100 candle-power, and at ninety degrees or the vertical it is 1,200 candle-power. The consumption of current is 385 watts per lamp, or a total of 4,620 watts. According to the above area, this figures 7.1 watts per square metre of lighted space. The advantage of using mercury vapor lamps will be seen when we find that the same lighting was carried out before with twenty-four arc lamps, each of which used 660 watts, making a total of 15,840 watts, or 24.4 watts per square metre, this being more than three times the figure for the vapor lamps.

---

According to recent reports it appears that the Japanese government intends to have erected a system of hydraulic plants of great size in the region of Tokio, and will deliver no less than 100,000 horse-power when fully completed. The plants are to be installed and operated by an Anglo-Japanese company, who have already been granted the necessary concessions for beginning the work. There are several falls lying within 100 miles of Tokio which the company intends to utilize in order to secure the amount of power which is needed. A number of power transmission lines will take current to Tokio, as well as to a number of other cities and large towns lying within

the radius. Owing to the high price of coal in Japan the plant will be operated under the best conditions and will no doubt be well patronized. The total expense of the proposed system will be no less than $10,000,000 according to the plans which the company have already drawn up.

---

A new method of applying electric motors in sawmills has been put in operation not long since, and it appears to be quite successful. The band saw is run after the manner of an endless belt between two discs, whose distance apart can be regulated by a suitable device so as to give the required tension. One of the discs is mounted directly upon the shaft of a fifty-horse-power motor. In this case the saw is placed horizontally, and the log which is to be cut up is placed on a sliding frame operated by a twelve-horse-power motor. When one board is sawed, the device carrying the band saw can be lowered by the right amount for cutting the next board, and so on.

C. L. DURAND.

Paris, June 22.

## COAL HANDLING IN SMALL PLANTS.

BY H. S. KNOWLTON.

In very small power plants it is difficult to generate current with the same economy per kilowatt-hour which is expected of large installations. The principal reason for this is the absence of methods of operation efficiently applicable to the production of power on a wholesale basis. Highly organized equipment designed to work economically on a large scale with expensive supervision is too costly for the plant of a few hundred kilowatts rating, and even with installations of two or three thousand kilowatts there is need to scrutinize fixed charges pretty carefully before deciding to invest in superheaters, economizers, forced-draft apparatus, mechanical stokers and automatic coal-handling systems. Plenty of cases come up in which the installation of one or more of these systems is desirable, but there ought to be definite figures back of each decision to use these auxiliary devices.

The small plant suffers from relatively high losses in the power-production process, referred to the output throughout the day. Direct economies in the use of fuel are difficult to secure, but much waste can be prevented by extra care that leaks in the high-pressure piping be stopped, by looking after the tightness of valves and traps, by using as far as possible the smaller engines for the lighter hours of the daily load, and by at least an annual calibration of the recording wattmeters on the switchboard. Anything which can be done to save labor without spending money for costly equipment is likely to pay well for all the time and thought bestowed upon it.

Particularly in the matter of handling coal one finds many small plants working under disadvantages. There is no blinking the fact that firing a boiler is not an easy job. Even the intermittent care of a domestic furnace is often a thorn in the flesh of the manager who can not see why enthusiasm is lacking in the boiler room of his power plant. The conditions in not a few small boiler rooms are so unfavorable to comfortable work that it is not surprising that the coal consumption seldom gets down where it ought to be. The room may be wretchedly lighted and without any means of artificial ventilation; there are likely to be no facilities for washing, nothing but a couple of chairs with the cane bottoms gone, for the use of the firemen between whiles; the gravity delivery of coal or the installation of industrial railroad tracks in the boiler-room floor may never have been thought of, and finally, the chief engineer may not give the work of the firemen proper supervision for any one of a number of plausible reasons. All these things may seem impracticable to the hard-headed manager who believes that the tendencies of human nature to shirk disagreeable duties can not be overcome by any species of welfare work, but it is the solid truth that they vitally affect the fuel consumption.

It is frequently possible in a small plant to store coal at a higher level than the boiler-room floor, perhaps outside the building. If this can be done one shoveling can be cut out. It is a great deal cheaper to dump the coal from the wagon originally above the boiler-room floor, where it has been hauled by a couple of stout draft-horses, than to raise it by hand. If one or more chutes can be arranged to deliver the coal upon the boiler-room floor in front of the boilers, so much the better, but in such cases the chutes should be equipped with a discharging device which will deliver a fixed quantity of coal each time, with an automatic record of the number of deliveries. An old revolution counter, or even a discarded cash register, can often be pressed into this service.

If the chute plan is not feasible on account of the distance of the raised coal pile from the boiler room, narrow-gauge cars can be installed to run between the coal bins and the boilers, and the passage of each carload checked off either manually or automatically. In some small plants the firemen seem to be perpetually pushing low-capacity wheel-barrows between the coal pile and the boilers, whereas with the use of narrow-gauge tracks, perhaps graded slightly downward toward the boilers, a much larger quantity of coal could be handled per trip, leaving the firemen larger periods of rest for the supervision of the boilers. If the industrial trackage provided parallel to the furnace fronts is supplemented by a siding, the fireman can change directly from his car to the furnaces, utilize the empty cars for taking up ashes, shunt this ash car on the siding and proceed with the charging operations from the next car. This latter arrangement also frequently does away with the necessity of extra labor during times of peak load, as often a sufficient number of cars can be loaded and placed on the track in the boiler room to carry the station through the hours of heavy output, thus cutting down the labor item. A minor point is the cleanliness possible with this arrangement.

With plants of 2,000 or 3,000 kilowatts capacity, the use of mechanical stokers charged by hand is sometimes advisable, but it is questionable if in plants of this size it pays to sustain the extra cost of steel work and direct overhead coal bunkers designed for large storage capacity with mechanical conveyers. An arrangement which does away with the frequently high cost of substantial building construction for bunkers is to install a traveling coal bunker which may be moved back and forth along the front of the boilers and set to discharge its load at any desired point. The use of a simple system of narrow-gauge tracks, the provision of plenty of light and windows which can be opened from the floor, with perhaps the use of an exhaust fan in the hot season, coupled with a few inexpensive arrangements for the personal comfort of the operating shifts, all mean better conditions in the boiler room, and they cost little in proportion to the beneficial results which they tend to produce. It is specious to argue that improvements of this kind are not needed because they may not reduce the pay-roll of a single man. Labor must be paid for, and in so far as the physical tasks of the boiler room can be lightened lies the opportunity to utilize the intelligent fireman for more responsible tasks having to do with lasting economy of fuel and better pay.

# REVIEWS OF CURRENT ENGINEERING AND SCIENTIFIC LITERATURE

### British Patents for 1906.

When the British Patents Act of 1902 went into effect, there was a great deal of misgiving because it was contended that the method of search to which it gave effect would be of little value, owing to the fact that the search applied only to British patents, and also because, as is well known, most patent actions in the law courts do not depend simply upon anticipation by previous patents, but upon the state of common knowledge at the time when the patent was filed. It was also felt that the fact of a specification being accepted by the Patent Office after search would be taken as an indication that the patent was certainly valid, thus giving it a spurious value. These forebodings do not appear to have been fulfilled. The new act only came into force in 1905; therefore the year under review, which is the second to which the act applies, is the first one which really indicates the true effects of the act. In 1905 complete specifications numbered 18,806, whereas in 1903 there were 15,831, and in 1904 there were 15,925. A considerable part of this increase was no doubt due to the more expeditious filing of complete specifications necessitated by the shortening of the time allowed for completion from nine to six months. In 1906 it is noticeable that the number of complete specifications was 18,228. As there is no corresponding explanation for the past year, it can only be concluded that inventors generally have appreciated the benefits of the official search. One effect of the search has been that a great number of specifications have been amended, such amendments being often the result of conference between the examiner and the applicant. It will be recognized how very generally modifications are desirable when it is mentioned that no less than 8,785 specifications were amended, out of a total of 15,369 that were accepted. With regard to the trend of invention during the past year, the small increase in the number of applicants over that of 1905 appears to be in a large measure due to activity in the automobile industry. There have been a large number of inventions to prevent skidding, and there were many applications for patents on emergency brakes.—*Abstracted from the Electrician* (*London*), *June* 14.

### Rail Corrugation.

In this article the contributor takes exception to some of the statements which have been published from time to time concerning the causes of rail corrugation. Where the statement has been made that the corrugations are caused through the bed in or on which the rails are laid being too hard or not rigid enough, the correspondent states that he knows of rails that are laid on concrete of almost all thicknesses, and also on longitudinal timbers buried in concrete and cross-sleepered with girder sleepers, some bolted together and some not; in fact, where the conditions of rigidity are ideal, and all of these rails were corrugated in certain places. He thinks this does away with the theory that the bed is responsible for the corrugation. The author concludes that routes used exclusively by bogies are corrugated. There is no corrugation on a straight-rail—that is, a rail which is straight and in line. There is no corrugation on the inner rail of a curve. There is no corrugation on a curve of less than 150 feet radius. Corrugations will form on any rail that is not straight, whether uphill or down, providing the rail forms the outer or longer rail of the curve or series of curves so made, and the cars travel quickly enough. If any engineer will pick out a bad rail on his system on a so-called straight road, and pull up the paving and slew the rails over a little so as to reverse the curve, he will see that the smooth rail will corrugate, and the corrugated rail will wear smooth. Or, again, put the rails straight and to line, and in a very few weeks all traces of corrugations will be gone. He thinks this is proof enough that neither the bed, the rails, the rolls, the chattering or hammering of the gear wheels, or the end drive is to blame for this trouble. Where two wheels are fast on one axle, each can revolve only the same number of times. Where one has to travel farther than the other, one must jump or stick to gain the difference in the distance covered. This accounts for corrugations being on the one rail, the outer. On slack curves, where the cars run quickly, the trouble is worse, and on roads not in line, but called straight, all places affected will be found to be as stated above—that is, on the longer rail forming a curve, however slight, and on one rail only.—*Abstracted from the Tramway and Railway World* (*London*), *June* 6.

### The Irish International Exposition.

The exhibition opened in Dublin, Ireland, on May 4, does the highest credit to Ireland, and should dispel forever the impression that the Irish lack energy and initiative, for purely Irish firms throughout the provinces have responded admirably to the occasion, both as guarantors and as exhibitors. The exhibition power plant is divided into two parts, half being driven by gas and half by steam. Steam is raised in three Babcock & Wilcox boilers fitted with chain grates of the close-link pattern driven at three speeds by means of an entirely enclosed change gear which runs in oil. Each boiler is rated at 10,000 pounds per hour. Feed water is supplied to the boilers by two Weir pumps. The four steam engines are of Irish make, two being by Combe-Barbour, and two by Workman-Yeames, both Belfast firms. Of the two gas engines, one is a National, and the other a Crossley. The fundamental idea underlying the power-station scheme was to have the units dissimilar, so that the whole should provide the greatest possible interest to visitors. Both Combe-Barbour engines are direct-coupled to Westinghouse generators, one rated at 400 kilowatts, 220 volts, and the other rated at 300 kilowatts, 500-550 volts. The Workman-Yeames engines are direct-coupled to General Electric dynamos, one generating at 460 volts, and the other at 230 volts. The 400-horse-power engine built by the National Gas Engine Company is direct-connected to a Siemens dynamo generating at 220 volts. The 180-horse-power Crossley engine is belt-connected to a General Electric 220-volt dynamo. The switchboard is a remarkably handsome specimen of low-pressure work, and was built by the General Electric Company. It is made up of Sicilian marble in nine panels, six for the dynamos and three for the main feeders. The grounds and buildings are illuminated by arc lamps; the grounds with 120 Santoni ten-ampere flame arc lamps run four in series on 220 volts; and the buildings, except under the dome, with 200 five-ampere Davy white arcs of the enclosed type, run

two in series on 220 volts. About 200 General Electric open-type arcs are also utilized, making about 520 arcs in all. Six thousand white and 6,000 ruby lamps outline the principal features of the central building. The change from one color to the other is made by means of a change-over switch specially designed by the Westinghouse Company for the purpose. It consists of a pair of large liquid motor-starters joined together, the blades being fixed to the same spindle. It is rated to change over full load 120 times an hour without boiling the water. About 1,500 lamps burning five in series outline the art gallery. There are a number of motors installed for a variety of purposes, such as ventilating fans for the restaurants, induced draft fans for the boiler house, water lifts for the water chute, and smaller pieces of apparatus.—*Abstracted from the Electrical Review (London), June* 14.

### The Electric Lighting of the Palace Theatre, London.

The Palace Theatre, on Shaftsbury avenue, located in the west end of London, England, was originally designed as a national opera house. It is one of the largest theatres in London, and is furnished and equipped with great magnificence. The mechanical equipment is particularly complete. The boiler house contains three Marshall locomotive-type boilers, each developing about fifty horse-power, and all are hand fired. There are two Pearn feed pumps, each capable of delivering about 600 gallons of water per hour. The engine room is equipped with three Willans compound engines direct-coupled to Siemens dynamos. These dynamos develop sixty-five kilowatts each. There is also a Willans-Parker thirty-five-kilowatt dynamo. The main switchboard is built up of substantial slate panels, and is provided with automatic overload and reverse-current cutouts in the machine circuits. In addition to the usual main and circuit switches there are also two watt-hour meters, one for measuring energy supplied to the back of the house, and the other for the front. The average load in the evening is about 1,200 amperes at 100 volts. By the side of the main board is a separate teak board, which is used solely for the engine and boiler room supply. Mounted on this board are the change-over switches which enable the attendant to throw over the entire lighting of the rooms to the Charing Cross Company's mains in the event of a breakdown. Nearly all repairs are carried out on the premises, and for this purpose a small workshop has been fitted up in a room next to the boiler house. The main house switchboard is situated in an underground brick chamber provided with an iron door. Altogether it controls some 3,000 lamps, and is divided into two sections, each of which is provided with a main change-over switch. There are some forty-four circuit switches and fuses on the board, two of which control fan circuits. These fans are driven by four-horse-power motors, and one is employed for drawing vitiated air out of the theatre, and the other for driving in warm air in the winter and cool air in the summer. There is a circuit separate from the main switchboard, and supplied only from the company's mains, carrying 300 emergency lamps. Adjoining the switchboard chamber there is a brick compartment accommodating a vacuum carpet cleaner driven by a six-horse-power motor. In the front of the house a new twenty-four-way branch switchboard has been installed. This carries ten-ampere tumbler switches mounted on a slate base. There is also a similar board of nine ways for controlling the decorative lights which outline the windows in the front of the house. The projectoscope instrument is housed in an iron fireproof room, and is provided with duplicate arc lamps. This apparatus takes 100 amperes. All necessary resistances are fixed in the same room, as are also change-over switches, so that if one source of supply fails, the other is immediately available. The main stage board is situated in the prompter's corner, about ten feet above the floor level. It is provided with change-over switches, each capable of carrying 200 amperes. In the aggregate, some 2,000 lamps are controlled from this point. There are forty-five circuit switches on this board. A somewhat unusual feature of the theatre lighting is the fact that a large number of auditorium lights, as well as those on the stage, are provided with dimmers. Thus, all the lamps in the large sunburner, as well as those on the various balconies, can be extinguished gradually or may be run at any desired degree of brightness. The footlights consist of 200 thirty-two-candle-power lamps. The lamp bulbs are at present all of clear glass, as it has been found that there is practically no demand on the variety stage for colored footlights. The footlights are supplied from three separate circuits, adjacent lamps being on different circuits, and there is a fuse for every fifteen lamps.—*Abstracted from Electrical Engineering (London), June* 13.

### Tar Oils for Diesel Engines.

When the Diesel engines were first introduced, it was thought that the great feature of the new motors rested on the fact that an engine had been brought out which would consume any kind of liquid fuel. As is often the case, the development took place on rather different lines. The Diesel engine showed its own preferences as regards fuel, just like the gasolene motor, and other difficulties had first to receive attention and be overcome. In Germany tar oils are broadly distinguished as lignite tar oils and coal tar oils. The tar oils gained from the distillation of wood and peat are not at present of much importance. Again, speaking broadly, lignite tar oils are considered a suitable fuel for Diesel engines, while most of the coal tar oils are regarded as unsuitable. Although there is no inducement to use a high-grade paraffine oil as fuel, general experience seems to have suggested that a tar oil containing more than 2.5 per cent of paraffine would not answer in Diesel motors. Paul Rieppel has found, however, that a higher percentage of paraffine did not in itself disqualify the tar oil as Diesel motor fuel. He raised the paraffine proportion by steps to 15.2 per cent, and worked with such fuels for more than fifty hours without experiencing any trouble. As, moreover, crude petroleum and gas oils of foreign origin containing considerably more than 2.5 per cent of paraffine answer perfectly in Diesel engines, the conclusion that the paraffine percentage was not, as such, a criterion for the suitability of the Diesel motor fuel appeared to be justified. Mr. Rieppel resolved to investigate the whole problem, with the object of ascertaining which oils and mixtures can be recommended, and the cause of their suitability. Benzine proved very unsatisfactory. There were mis-fires and violent explosions. The exhaust would shoot out as a column of fire and soot, and pistons and valves became badly tarred. Mixtures of benzine with tar oils, especially the creosote and anthracine oil, worked well.—*Abstracted from Engineering (London), June* 14.

## Illinois Contractors' Annual Meeting.

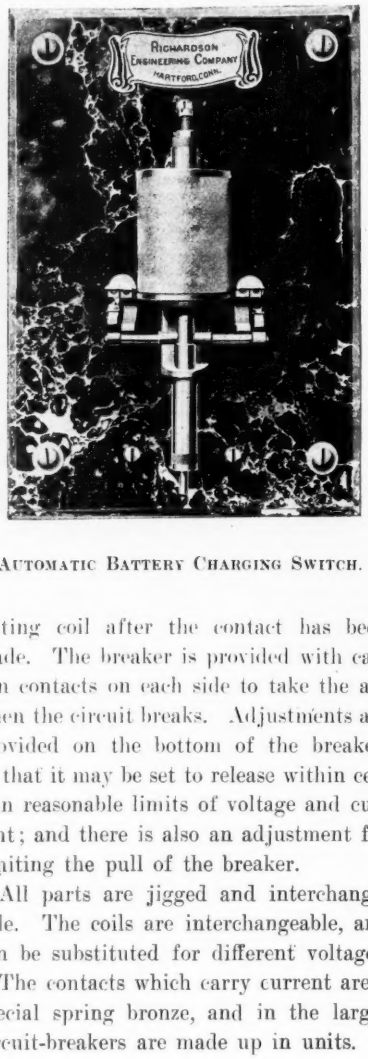
The annual meeting of the Illinois State Electrical Contractors' Association was held on Saturday June 15, at Danville. Officers were elected as follows: President, F. D. Bolte, East St. Louis; vice-president, T. D. Allen, Danville; secretary, A. F. Frankeberger, Danville; treasurer, J. Pierce, Chicago; directors, H. O. Peterson, Chicago; J. B. Scholes, Springfield; G. A. Lieber, Jacksonville. J. T. Marron was elected a delegate to the national convention in New York city, July 16-18.

# INDUSTRIAL SECTION

**ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS**

## Automatic Storage Battery Charging Switch.

The Richardson Engineering Company, Hartford, Ct., has placed on the market an automatic storage battery charging switch, an illustration of which is shown herewith. This switch makes connection automatically between the generator or source of current and the storage battery when the voltage is high enough to charge the battery, and disconnects the circuit automatically when the voltage falls too low. Each switch is furnished for a specific voltage or for charging a certain number of cells of storage battery. A series coil is employed to assist the voltage se-




AUTOMATIC BATTERY CHARGING SWITCH.

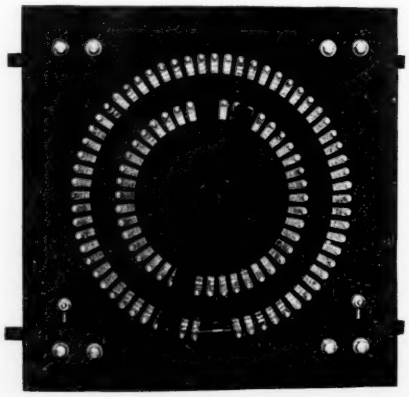
lecting coil after the contact has been made. The breaker is provided with carbon contacts on each side to take the arc when the circuit breaks. Adjustments are provided on the bottom of the breaker, so that it may be set to release within certain reasonable limits of voltage and current; and there is also an adjustment for limiting the pull of the breaker.

All parts are jigged and interchangeable. The coils are interchangeable, and can be substituted for different voltages.

The contacts which carry current are a special spring bronze, and in the larger circuit-breakers are made up in units.

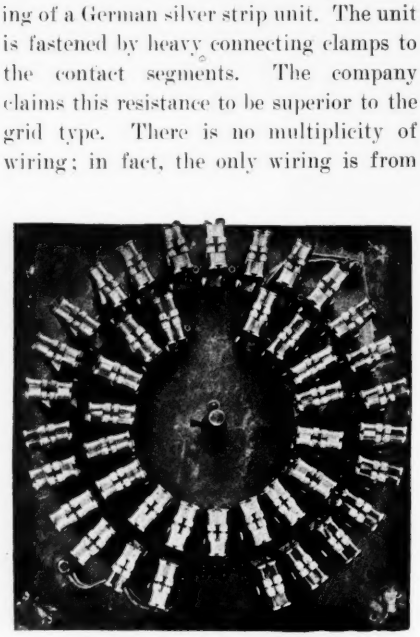
## Heavy-Duty Field Rheostats.

The accompanying illustrations show front and rear views of the latest type heavy-duty field rheostat placed on the market by the Ward Leonard Electric Company, Bronxville, N. Y. In this rheostat



FRONT VIEW, HEAVY-DUTY FIELD RHEOSTAT.

there is one unit per step, each step consisting of a German silver strip unit. The unit is fastened by heavy connecting clamps to the contact segments. The company claims this resistance to be superior to the grid type. There is no multiplicity of wiring; in fact, the only wiring is from

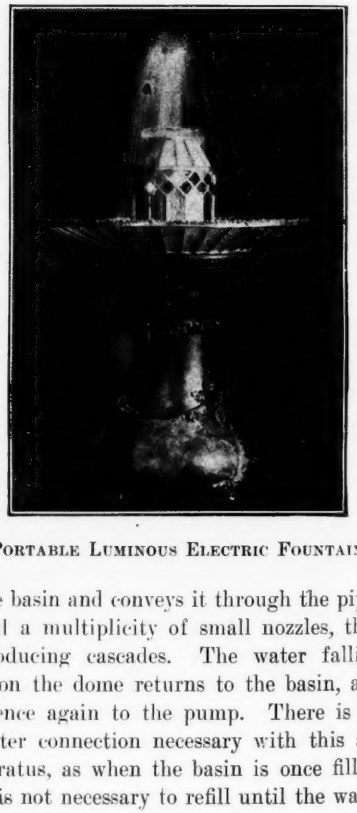


REAR VIEW, HEAVY-DUTY FIELD RHEOSTAT.

the final terminal unit to the connecting post. Paralleling of resistances is eliminated. The centre of the stud on the base does not carry current, and the contact is made between segments and heavy flexible shoes, insuring perfect contact.

## Electric Fountains for Decorative Work.

The New York Electric Fountain Company, 114-116 West Thirty-ninth street, New York city, is meeting with success in placing its electro-luminous and portable table fountain. An illustration of the type "A" fountain is shown herewith. The base is thirteen inches in diameter, and the height to the top of the dome is twenty-six and one-half inches. The base of the fountain is in antique metal, and the catch basin and dome are made of leaded glass. This fountain is composed of a small motor and a centrifugal pump, the latter placed in the interior of a basin and connected directly to the motor shaft. The pump takes the water directly from



PORTABLE LUMINOUS ELECTRIC FOUNTAIN.

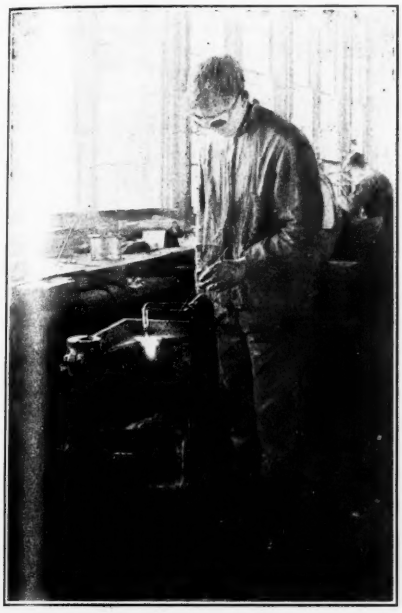
the basin and conveys it through the pipes and a multiplicity of small nozzles, thus producing cascades. The water falling upon the dome returns to the basin, and thence again to the pump. There is no water connection necessary with this apparatus, as when the basin is once filled, it is not necessary to refill until the water diminishes by the process of evaporation.

To produce the play of the fountain and its effects it is only necessary to attach the wire to any circuit and turn on the switch. The dome is illuminated by an incandescent lamp, and revolves by means of a jet of water driven against flanges on the under side of the rim of the dome.

## Autogenous Welding.

Oxygen and acetylene in a blowpipe flame produce the highest temperature (6,300 degrees) of any flame as a product of combustion. It is 1,200 degrees higher than the oxyhydrogen flame and nearly equals the electric arc.

This process is valuable for replacing riveting and brazing in many instances.



WELDING CAST IRON.

Two sheets of metal may be welded by placing their edges in contact and following along the seam with a blowpipe. This autogenous welding process is especially valuable in the foundry, as the blowholes and similar defects in castings and forgings are made good. Cast iron, wrought iron, steel castings and forgings, copper, brass, bronze and aluminum in many forms of construction are effectively welded, either in the manufacture of new parts or in repairing accidental breaks.

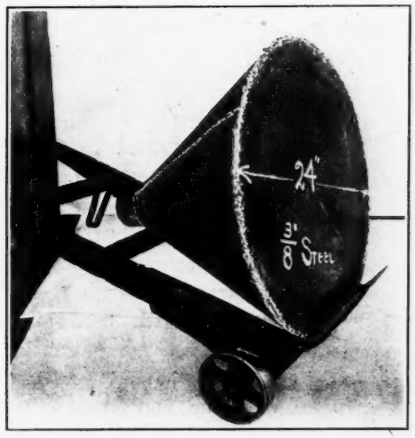
To insure strength, the joint is slightly overloaded by melting a wire or rod of same material as metal to be welded, at the same time the edges are fused. The unfinished joint is stronger than the body of the metal and the finished joint is practically the same.

Any shaped hole can be cut in steel plates up to six inches in thickness, as with the blowpipe the operator can accomplish cutting feats impossible with a saw. In cutting, the flame is proportionately elongated by pressure to penetrate to the bottom of the cut. The intense heat is so localized that the kerf is practically the same as if a saw were used.

A plant for autogenous welding with this process has recently been installed at the Worcester Pressed Steel Company, Worcester, Mass., which is the second in this country.

The oxygen and acetylene are each generated in a separate apparatus and conveyed through separate pipes to the blowpipe. The distinctive feature which has done the most to make this welding process of wide commercial value is the introduction of a means for producing oxygen. By combining this chemical product with water, chemically pure oxygen is as easily obtained as in uniting calcium carbide and water, acetylene is liberated; the chemical reaction in each case being analogous.

The oxygen generating apparatus consists of two lead-lined generating chambers arranged with a scrubber and set-

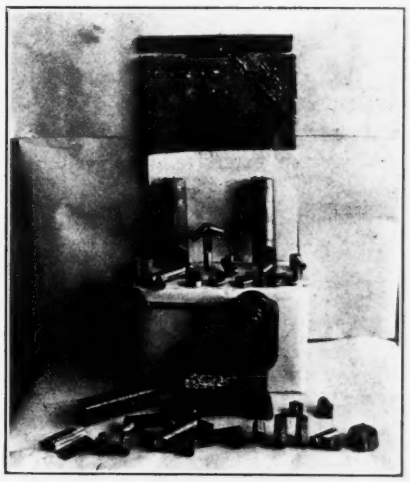



WELDED THREE-EIGHTHS-INCH STEEL TANK.

tling chamber between. In making oxygen, one generator is filled with the required amount of lukewarm water, to which one chemical charge is added. While this solution is being stirred with an agitator, operated by a crank, provided for the purpose, a solution of iron sulphate and water is added, which acts as a catalyzer.

The oxygen liberated passes from the generator through the scrubber and a water-sealed trap into the gasometer; from the gasometer the oxygen is compressed to ten atmospheres (147 pounds) with an air-compressor into a pressure storage tank. It is then conducted through three-eighths-inch copper piping from which branches of one-fourth-inch copper piping lead to the blowpipe connections. Reducing valves are arranged so the operator can vary the pressure of the gas at the blowpipe at will. Each blowpipe is supplied with twenty-two different-sized nozzles so the size and power of the flame are varied according to the thickness of the metal to be welded.

The acetylene generator is of the water-feed type, composed of a cylindrical-shaped tank, which serves as a gasometer and regulator, connected by three water supply pipes to three carbide receptacles or trays, half cylindrical in shape, each containing six compartments. Each tray holds about twelve pounds of lump carbide. The acetylene is used under practically a uniform pressure varying from 2.2 to three pounds. The pressure is obtained and maintained by two water-levels in the gasometer, employing as a means the principle of the well-known water column, which automatically governs the supply and pressure of the gas. Any pressure in excess of three pounds escapes through a vent or blow-off outside the generator building. From the regulator and gasometer, the acetylene is conveyed through a one-inch main pipe with one three-eighths-inch



WELDED PARTS.

branch leading to each blowpipe connection.

A feature of this acetylene apparatus is a "safety valve" located between the blowpipe connections and the acetylene gasometer. This consists of a one-inch pipe leading into and two one-inch pipes leading out from the rectangular metal chamber. The inlet pipe connects with the gasometer. One outlet conveys the acetylene to the blowpipes, the other vents to the outside air. The inlet and outlets are separated by a water-sealed trap which prevents any possibility of ignition reaching the generator and gasometer by burning back through the blowpipe supply pipes.

The blowpipe is of brass construction specially designed on the injector prin-

ciple and carefully proportioned for its intended purpose. It is about twenty-four inches long and weighs two pounds. It is provided with two inlets which remain entirely separate practically the entire length of the blowpipe and enter a mixing chamber with a common outlet at the point of combustion.

In lighting the blowpipe, the acetylene is first turned on full; then the oxygen is added until the flame has only a single cone. At the apex of this cone the temperature is 6,300 degrees Fahrenheit. In welding, this point is held from one-eighth to one-fourth inch distant from the metal to be welded. Too much acetylene produces two cones and a white color; an excess of oxygen is indicated by the flame assuming a violet tint.

The total heat generated per cubic feet of acetylene is about 1,500 British thermal units, which, aside from the initial decomposition, is furnished mainly by the combustion in oxygen of the carbon into carbon dioxide and in lesser degree by the combustion of hydrogen into water vapor. Pure acetylene at a pressure of less than thirty pounds, even when passed through pipes at white heat, is safe, but when mixed with oxygen (or air) is dangerous. An explosive gas mixture enclosed in a pipe does not inflame at once throughout the entire pipe but from one end of the pipe; ignition travels at a certain speed which increases as the square of the pipe section; therefore, to render safe the use of oxygen and acetylene in the blowpipe flame, the gas mixture is given a speed by pressure greater than the rate of propagation of the flame. No flux or molds are required to weld metals such as iron, steel and copper, but for alloys, *viz.*: Brass, bronze, etc., a little borax or boracic acid, moistened with water, is used to prevent the volatilized zinc from being deposited on the joint and destroying the weld. This process welds by fusion, forming a metallic union of the parts, which is imperceptible after finishing.

An operator of average ability can weld steel or copper sheets at the rate and cost for gas approximately as follows:

| | | | |
|---|---|---|---|
| .035" | (about 1/32") | 288" per hour, | $0.0031 per inch |
| .062" | (about 1/16") | 200" per hour, | .0065 per inch. |
| .125" | (about 1/8") | 120" per hour, | .016 per inch. |
| .377" | (about 3/8") | 60" per hour, | .057 per inch. |

The Worcester Pressed Steel Company has accomplished some difficult autogenous welding with aluminum, practically overcoming the trouble from the oxide which forms on the surface of aluminum when exposed to the atmosphere. Although aluminum melts at a comparatively low temperature (1,200 degeres Fahrenheit) it rapidly conducts and absorbs heat and requires a high local heat to obtain the best results.

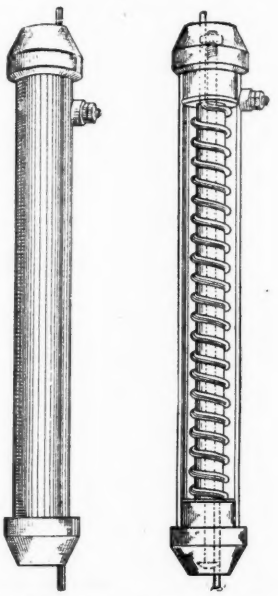
## The Fox Terminal Hood.

The Fox Manufacturing Company, Milwaukee, Wis., has placed on the market the Fox terminal hood, illustrations of which are shown herewith. These terminal hoods are especially designed for fire and weather-proof service, for railway work, transformer insulation, fire-alarm, telephone exchange, isolated plant and street lighting systems, and for all outside wiring and entrance work. The splice, if necessary, can be made under the hood, which is easily put on and does not require a threaded pipe. The hood is made to fit every size of pipe and every size of wire. Conduit can be brought through the base and continued from one hood to another as easily as the wires themselves.

THE FOX TERMINAL HOOD.

## The "Sky Rocket" Lightning Arrester.

The Chance Manufacturing Company, Centralia, Mo., has placed on the market a new form of lightning arrester for telephone, telegraph and other electrical circuits, designated as the "Sky Rocket" arrester, owing to its appearance. This arrester contains a choke-coil made up of the same size and quality of wire as the line conductor, formed on a porcelain tube and placed within a grounded steel tube, separated therefrom by a heavy porcelain bushing at both ends. This bushing allows a thin air space between the coiled line conductor and the grounded tube.



THE "SKY ROCKET" LIGHTNING ARRESTER.

The arrester is placed outside of the building in series with the line. The lightning must take twenty-two convolutions within the grounded tube before it can enter the apparatus which is being protected.

## Good Year for Car Building.

The annual report of the American Car and Foundry Company for the year ended April 30, shows an increase in gross and net earnings over last year. At the stockholders' meeting held in Jersey City on June 27, A. B. Hepburn, president of the Chase National Bank, was elected a director to succeed Walter J. McBride.

The figures shown by the income account are as follows: Gross earnings, $11,115,087, compared with $5,648,553 last year; net earnings, $9,347,084, compared with $4,158,450; balance available for dividends, $8,139,536, compared with $3,807,660; balance, $6,039,536, compared with $1,357,660; surplus for the year, $5,439,536, and total surplus $19,552,630.

Clarence Price, formerly general sales agent, was elected a vice-president, and William M. Hager, formerly assistant secretary, was made secretary.

# Current Electrical News

## DOMESTIC AND EXPORT.

NEWARK-JERSEY CITY MONORAIL SCHEME—Plans are said to be under way to build a monorail electric railway in New Jersey between Newark and Jersey City. The system is the invention of H. H. Tunis, a civil engineer of Baltimore, Md. It is understood that John H. Starin, of New York, Charles Stewart Smith and Woodbury Langdon are financially interested in the project.

MORE CAPITAL FOR THE TRI-CITY RAILWAY COMPANY—An amendment to the articles of incorporation of the Tri-City Railway Company has been filed announcing the increasing of the capital stock of the company from $1,500,000 to $2,500,000. The amendment is signed by J. F. Potter, president, and H. E. Weeks, secretary. This increase in stock will enable the company to carry out its vast plans for improvement of the car lines.

INDIANA TRACTION LINES UNITE—The Evansville (Ind.) Railway Company has been incorporated with a capital stock of $1,000,000. The incorporation consolidates the Evansville, Rockport & Eastern with the Evansville & Mount Vernon, both completed traction lines. It is proposed to build through to Louisville. The officers are: president, W. L. Sonntag; vice-president, C. H. Battin; treasurer, M. S. Sonntag; secretary, F. W. Reitz; chairman board of directors, William H. McCurdy.

RAILROAD RIGHT OF WAY—The Supreme Court decided on June 21 that an interurban railway company operating a leased road has power to condemn a right of way for a transmission line from its power-house to the leased line. The question was raised by the condemnation of a way from the power-house of the Indianapolis & Cincinnati Traction Company across to the road from Greensburg to Indianapolis, which the company operates under a lease. Leonidas H. Mull objected to having the wires cross his farm in Rush county, but the Circuit Court decided against him and its decision was affirmed.

ONEIDA RAILWAY COMPANY INCREASES CAPITAL—The Oneida Railway Company held a meeting on June 22 at which it was voted to increase the capital stock from $15,000 to $2,000,000. The additional stock will be issued almost entirely to pay the cost of electrifying the West Shore Railroad, which was done under this company's management. The Rome City Railway Company at a meeting Saturday also voted to increase its capital from $150,000 to $500,000. A small part of this increase will be used to pay for improvements recently made, and the balance will be held in the treasury to pay for extensions that are contemplated.

NEW MEXICAN ELECTRIC LINE—Dr. J. W. Lim, of Torreon, one of the stockholders of the Banco de China y Mexico, and other wealthy Chinamen of Torreon and northern Mexico, have secured from the state government the right to build and operate an electric line between Torreon and Matamoros, Coah., a city about ten kilometres from Torreon and situated in the heart of the cotton-producing country of Mexico, known as the Laguna district. Matamoros has a population of about five thousand people. The machinery has been ordered from the United States and work will begin at a very early date. The engineering is being done by a local engineering firm, Lineberg & Rone.

BUFFALO, GENESEE & ROCHESTER RAILWAY COMPANY MAY BUILD LINE—The state board of railroad commissioners has unanimously granted a certificate of necessity to the Buffalo, Genesee & Rochester Railway Company, which proposes to build a double-track street surface railroad from Depew to Rochester, a distance of sixty miles. The road will also take up the Buffalo & Depew Railroad, which is now in operation. The road will run through the towns and villages of Lancaster, Crittenden, Corfu, Batavia, Le Roy and Chili. The capital stock is $7,500,000. The board has also consented to the issuance of a mortgage for $5,000,000 by this company, the proceeds to be used for the purpose of its financing.

PENNSYLVANIA TUNNEL CONSOLIDATION—The Pennsylvania Railroad Company has consolidated its two tunnel companies, known as the Pennsylvania, New Jersey & New York Railroad Company of the State of New Jersey and the Pennsylvania, New York & Long Island Railroad Company of the State of New York, and the name of the consolidated company is Pennsylvania Tunnel and Terminal Railroad Company. By this consolidation a duplication of corporate and accounting work will be abolished and the completion of the Pennsylvania Railroad's New York tunnel extension will be continued by the consolidated company. The directors named in the articles of incorporation are: James McCrea, of Ardmore, Pa.; John P. Green, Rosemont, Pa.; Charles E. Pugh, Overbrook, Pa.; Samuel Rea, Henry Tatnall, Bryn Mawr, Pa.; William Burns, Philadelphia; Thomas Dewitt Cuyler, New York; Clement A. Griscom, head of the International Navigation Company, Haverford, Pa.; John D. Crimmins, New York, and F. L. Sheppard, Long Branch, N. J.

IOWA INTERURBANS TO COMBINE—It is stated that the interurban railway companies of Iowa have practically perfected an agreement to issue interchangeable mileage books good on all electric lines in the state. The details of the agreement have not been announced, but it is understood that an organization will be conducted the same as the Western Passenger Association, which acted as a clearing house for the interchangeable credential books that have been issued for years by western roads. The object of the movement is said to be to advertise electric lines in various parts of the state and also to promote business. Traveling men who cover the entire state would thus be enabled to buy a mileage book and get a rate of one and one-half cents per mile over electric lines at many points instead of paying two cents on the steam roads. There are several electric railways in operation now. Among them are the Polk electric lines out of Des Moines, the Fort Dodge, Boone & Des Moines line, the Cedar Rapids & Iowa City, the Clinton & Davenport line and the Waterloo, Cedar Falls & Waverly line.

MAY ELECTRIFY NICKEL PLATE ROAD—The Nickel Plate Railroad may be called upon to solve the problem of through trolley traffic between Cleveland and Buffalo, forestalling the efforts of the original trolley builders to complete electric service between those cities. With only a few short links remaining to be built to complete the trolley chain around the south shore of Lake Erie, the chances are now considered better than ever in favor of the steam lines that the electrification of the latter will head off the efforts of the pioneer electric railway builders. At present the passenger traffic of the Nickel Plate on its entire mileage from Buffalo to Chicago is said to be only about $3,000 per mile per annum. The Lake Shore Electric is earning between Toledo and Cleveland over $5,000 per mile per annum. The Cleveland, Painesville & Eastern electric line earns over $10,000 per mile per annum. These figures show the amount of passenger traffic that could be diverted to the Nickel Plate if converted to electric equipment. It would not only make a strong bid against the trolleys for suburban traffic but would draw largely from the unprofitable short haul business of the Lake Shore.

## DATES AHEAD.

Jamestown Tercentennial Exposition. Norfolk, Va., April 26 to November 30.

National Electrical Contractors' Association. Annual meeting, New York city, July 17-19.

Illuminating Engineering Society. Annual meeting, Boston, Mass., July 30-31.

International Association of Municipal Electricians. Norfolk, Va., August 20-22.

Ohio Electric Light Association. Annual meeting, Toledo, Ohio, August 20-22.

Canadian Electrical Association. Annual convention, Montreal, Quebec, September 11-13.

Railway Signal Association. Annual meeting, Milwaukee, Wis., October 8-10.

## ELECTRIC LIGHTING.

LITTLE VALLEY, N. Y.—At a special election it was voted to enlarge the electric plant, at a cost of $8,000.

WARRENSBURG, MO.—The Magnolia Light, Heat and Power Company, which owned the Warrensburg lighting plant, has sold the plant to a Philadelphia syndicate for $50,000.

CHICOPEE, MASS.—The appropriation of $19,000 requested by Manager George E. Stebbins for alterations in the arc-lighting system of Chicopee has been granted by the board of aldermen.

KITTANNING, PA.—The Kittanning & Leechburg Railways Company has closed a deal for the purchase of the plant and franchises of the Kittanning Electric Light Company, the consideration being something over $25,000.

LIMA, OHIO—Plans have been drawn for a $30,000 auxiliary to the present electric light plant, which is operated in connection with the waterworks system. The city expects to do a commercial business in addition to the city lighting.

ST. LOUIS, MO.—A mutual electric lighting company is projected for residents of the thickly populated suburban towns of St. Louis county. Its formation is being urged by B. H. Matthews, and a number of residents of Wellston and Clayton.

WARRENSBURG, MO.—A Philadelphia syndicate has closed a deal for the electric light plant at this place. The plant is one of the finest in Missouri and will be greatly improved. The same syndicate owns the Trenton, Mo., light and power plant.

SCOTTSBORO, ALA.—There is a movement on foot for the establishment of an electric light plant in this place. Several well-known citizens of the town are behind the enterprise, and the probabilities are that such a plant will be established.

COLUMBUS, GA.—The city council has passed an ordinance calling for an election on October 10 on the issuance of $100,000 of four per cent bonds to run for twenty-five years, the proceeds to be used in the construction of a municipal lighting system.

NEW CASTLE, PA.—A roundhouse and electric lighting plant are to be installed here this year by the Pennsylvania Railroad Company at a combined cost of nearly $275,000. The electric plant will furnish light to the railroad yards, which are several miles in length.

NIAGARA FALLS, N. Y.—At a meeting of the reservation commission W. C. Thayer, of East Aurora, was awarded the contract for the completion of the electric light system on the state lands in this city. The legislature recently appropriated $14,000 for this purpose.

LAWRENCEBURG, TENN.—Lawrenceburg is to have electric lights and waterworks. E. C. Kirkpatrick, civil engineer, has been employed by the city to make the necessary surveys, and oversee the work of erecting and putting in operation a plant of this kind. Work will be pushed to completion.

MORRISTOWN, N. J.—At a special meeting of the board of aldermen the contract for electrical street lighting awarded Peter V. Stryker was transferred to a company organized by Mr. Stryker in conformity with a previously understood agreement. It is known as the Morris & Somerset Electric Company.

ATLANTA, GA.—Stone & Webster are completing surveys for a large water power development, which they are financing, on the Chattahoochee river just below West Point, Ga. About 28,000 horse-power will be furnished, all of which will be taken by cotton mills and electric railways in the vicinity.

ALBANY, N. Y.—The Corinth Electric Light and Power Company, to operate in the towns of Saratoga county, has been incorporated at the office of the secretary of state. The capital is $25,000 and the directors are: Warren Curtis, of New York; Warren Curtis, Jr., of Corinth, and F. B. Coolidge, of Glens Falls.

ALBANY, N. Y.—The state commission of gas and electricity has approved the application of the Beaver River Light and Power Company to transact business in Lowville, Lewis county, and to issue $40,000 stock and $120,000 bonds and to acquire the stock of the Wetmore Electric Company, now operating in that village.

HOUGHTON, MICH.—The city council has entered into a five-year contract with the Houghton County Electric Company for lighting the city. The rate is to be $80 per lamp. It is provided in the contract that if a better rate is given any other town in the county during the five years Hancock shall receive a similar rate.

RICHMOND, IND.—The common council of this city has issued an appeal to citizens to support the municipal lighting plant, in the face of competition. The plant was established five years ago at a cost of $250,000 and the city is now asked to invest about $60,000 for repairs and betterments in order that it may compete successfully with the private plant.

CANANDAIGUA, N. Y.—The Ontario Light and Traction Company has executed contracts for the rebuilding of the old electric light plant at Littleville, from which Canandaigua, Shortsville and Manchester are supplied with electricity. The plans call for a new concrete building, and the machinery will be the most up-to-date obtainable. The old building will be abandoned.

OTTAWA, ONTARIO—The statement of accounts of the municipal electric plant for the half year ending May 31 shows a gross profit of $14,675. Deducting interest and sinking fund on $250,000 bonds, leaves a net profit for the half year of $7,050. The capital account shows a net expenditure for the half year of $13,174. The net profit has been carried to profit and loss account.

SILVERTON, COL.—The city council of Silverton has contracted for electric current from the Animas Power Company which has lines passing through the city from its plant on the Animas river to the mines and mills in the Upper Animas valley. The price to be paid the power company is one and one-half cents per kilowatt-hour with a guaranteed consumption of 40,000 kilowatt-hours per month. The contract is for five years.

ALBANY, N. Y.—The Long Sault Development Company, which received a charter from the legislature at its present session in a bill introduced by Senator O'Neil and signed by the governor for a certain annual compensation to the state, has filed acceptance of the charter with the secretary of state. The company has been authorized to develop electrical power on the St. Lawrence river at Long Sault island. It has a capital of $1,000,000.

SEARCHLIGHT, NEV.—A number of mining men of this place are promoting a scheme for the installation of a large electric power plant on the Colorado river that will furnish power and light to all the mines and towns in the southern portion of Nevada and particularly to the mines of Searchlight. The promoters state that a large power plant could be built on the Colorado river and that power could be supplied to hundreds of mines and also in operating electric railroad lines in this section.

PITTSBURG, PA.—It is said that wealthy men of Braddock, East Pittsburg and Wilmerding are interested in the formation of three new electric lighting companies. These will work in connection with the United Electric Light Company, of Wilmerding. Application for charters will be made shortly by W. J. Hally, of Wilmerding; Philip Geiss, of East Pittsburg, and Henry Harris, of Braddock, for the Braddock Electric Light Company, East Pittsburg Electric Light Company, and the North Braddock Electric Light Company.

PROVIDENCE, R. I.—At the reorganization and adjourned annual meeting of the stockholders of the Woonsocket Electric Machine and Power Company, 4,827 shares were represented out of the 5,000 shares. The stockholders elected the following directors: George Batchelor, John J. Hefferman, George R. Smith, Frank E. Holden, all of Woonsocket; Frank A. Sayles, of Pawtucket; Frank B. Bemis, of Boston; Steadman Buttrick, of Boston; Fred A. Arnold, of Boston; S. Howard Martin, of Boston. Messrs. Bemis, Buttrick, Arnold and Martin are engaged in the banking business connected with Estabrook & Company.

ATLANTA, GA.—The electric lighting contract with the Georgia Railway and Electric Company has been signed. This contract becomes effective April 24, 1908, in regard to private consumers as well as the city. The bid for lighting the city for a period of five years was $60 per arc light the first year, $59 the second year, $58 the third year, $57 the fourth year, and $56 the fifth year—an average of $58 per light for the term of five years. Power rates to the private consumer are reduced from seven cents per kilowatt-

hour to six cents. This affects a relatively small proportion of the city, and is said to be satisfactory to these consumers.

DES MOINES, IOWA—A material reduction in the existing rates for electric lights has been announced by the Des Moines Edison Light Company, effective July 1. Meter rates for lights in residences are reduced between thirty and forty per cent. Meter rates for lighting service, which are now fourteen and seven cents, will be decreased to twelve and six cents. This is a reduction of over fourteen per cent. This latter reduction affects the business houses of the city. The reason offered by the company for this voluntary lowering of rates is that the increased use of electricity for lighting has enabled it to furnish cheaper power.

BALTIMORE, MD.—It is stated that within the near future a new electric light and power company will be formed for the purpose of supplying with power and light the region in the vicinity of Monterey, Blue Ridge Summit, Buena Vista, Highfield, Pen-Mar and other resorts of the Blue Ridge. Those interested in the project are associated with the Blue Ridge Land and Hotel Company, one of the directors of which, A. M. Hurlock, says that arrangements have been made with the Waynesboro Electric Light and Power Company, whereby that company will furnish the necessary power to be distributed by the new company. One of the contemplated improvements is an electric railway from the Blue Mountain House to Pen-Mar Park, High Rock and Mount Quirauk.

## NEW INCORPORATIONS.

GRAND JUNCTION, COL.—The Western Electric and Hydraulic Company. $100,000.

NASHVILLE, TENN.—Van Buren County Telephone Company, Van Buren county. $5,000. Incorporators: Thomas A. Head, E. T. Passons, W. A. Graham, O. P. Passons and L. T. Hutchison.

MONTGOMERY, ALA.—Cumberland Telephone and Telegraph Company of Alabama, of New Decatur, Morgan county. $5,000. Incorporators: George R. Knox, Jr., Charles Carter and John C. Eyster.

TRENTON, N. J.—Morris & Somerset Electric Company, registered office, Morristown. To construct and operate electric works. $500,000. Incorporators: Francis Lundon Humphreys, John M. Forbes, Samuel H. Gillespie and Peter V. Stryker.

GLADSTONE, MICH.—Escanaba Electric Pulp and Power Company. To develop water power on the Escanaba river, midway between Escanaba and Gladstone. Incorporators: O. L. Huie, Marinette, Wis.; P. L. Utley, of Watertown, Wis.; and John Strange, of Menasha, Wis.

SALT LAKE CITY, UTAH—The Utah & Wyoming Independent Telephone Company, of Randolph, Rich county. To engage in the telephone business in Rich county. $10,000. Officers: State Senator Wesley K. Walton, president; Charles W. Walton, secretary; George Spencer, managing director.

DOVER, DEL.—The Merchants' Power Company. To manufacture and deal in general electrical products, to engage in the business of generating and distributing light, heat and power. $2,000,000. Incorporators: Jesse J. Riggs, of Chicago, and James L. Wolcott and James Virden, of Dover.

BOUNTIFUL, UTAH—Bountiful Light and Power Company. To establish an electric light and power system throughout the southern part of Davis county, purchasing power from the Utah Light and Railway Company. Directors: James A. Eldredge, Starns Hatch, William Doxie, Charles R. Mabey, Lamoni Call, Dan Duir and Andrew Grant.

SPRINGFIELD, ILL.—The Springfield, Beardstown & Quincy Railway. To build an interurban line from Springfield to Quincy, through Petersburg, Chandlerville and Beardstown. $25,000. Incorporators: Henry H. Colby, Robert B. Bone, Charles W. Houghton and John S. Hurle, of Petersburg; John J. Tolan, Farmingdale; Charles W. Brown, Jacksonville, and George L. Harnsberger, of Springfield.

BURLINGTON, IOWA—Burlington-Bonaparte Interurban Railway Company. To build an electric line between Burlington and Bonaparte, and to purchase, lease and otherwise acquire and maintain street railways and electric power plants. $10,000. Officers: president and director, J. A. Johnson; first vice-president and director, John Blaul; second vice-president and director, T. J. Lampe; treasurer and director, H. H. Meek; secretary, E. E. Egan; directors, Dan Cresap, A. G. Roberts, C. C. Paule, Luke Palmer and W. E. Blake.

## TELEPHONE AND TELEGRAPH.

TOPTON, PA.—The Consolidated Telephone Company has completed a second circuit between Topton and Kutztown.

ALBANY, N. Y.—A certificate of merger of the Greenfield Telephone Company, of Ulster county, and the Hudson River Telephone Company has been filed with the secretary of state.

NASHVILLE, TENN.—The Cumberland Telephone and Telegraph Company reports gross earnings for May of $477,753, an increase of $39,237; net of $151,534, an increase of $6,004, and surplus, after charges, of $134,743, an increase of $5,289. For five months the gross earnings were $2,404,453, an increase of $220,011, and net $899,993, an increase of $76,146. The surplus, after charges, was $725,905.

SUMNER, IOWA—The entire property of the Sumner Telephone Company is now in the hands of E. A. Hurmence, who has been more or less interested in the business ever since its first organization. The property embraces all the independent lines in the six or eight counties in the northeastern part of the state and is valued at about $160,000. New territory will be entered at once and no expense will be spared in improving the system.

WINAMAC, IND.—The Winona Telephone Company, owned by A. B. Diggs and Samuel R. Tomlinson, of Winamac, and W. S. Daniels, of Knox, has closed a deal for the Plymouth telephone exchange and all connecting farmers' and toll lines. The consideration is $30,000. The Plymouth exchange has 500 subscribers, and toll lines connecting with South Bend, Argos, Bourbon, Bremen and Etna Green. The Winona Telephone Company now owns the exchanges in the three county seat towns—Winamac, Knox and Plymouth—and also owns exchanges at Kewanna, Hamlet, Grass Creek and Monterey.

IRVINE, KY.—The Irvine Telephone Company has been organized and articles of incorporation filed. The company is composed of a number of citizens of the town and county, all the stock being taken up by local capital. Work of putting in an exchange at this place and extending lines throughout the county will begin immediately. The capital stock is $2,000. The incorporators and officers are: Thomas Williams, president; James A. Wallace, vice-president; Hugh Riddell, secretary; O. W. Witt, treasurer; J. C. Potts, A. M. Burbin, Robert R. Friend, F. R. Davidson, E. F. Davidson, C. W. Sale, C. Marcum, J. P. Miller, C. T. Grinstead, W. P. Williams.

ROCHESTER, N. Y.—Justice Nathaniel Foote, of the Supreme Court, has handed down a decision denying the motion of the Utica Home Telephone Company to vacate an injunction secured by the Independent Telephone Securities Company to prevent an increase of the capital stock of the Utica Home Telephone Company and to restrain the latter from issuing or selling any such increased stock. Justice Foote holds that the increase of the stock would violate an agreement of the company and enable a majority of the stockholders to increase the capital stock and secure control of the company and dictate its policy. The consent of every stockholder of the original company, it is held, must be secured before the increase of stock can be legally accomplished.

TOLEDO, OHIO—At the annual meeting of the Cuyahoga and United States Telephone Companies, held in Cleveland, C. Y. McVey and Norman C. McCloud, of Cleveland, and Clarence Brown, of Toledo, were elected to succeed Willard Robison and Jay K. Secor of this city, and F. S. Dickson, of Cleveland, on the board of directors. W. L. Cary, Jr., M. C. Harvey, of Cleveland, and H. H. Ashbrook, of Toledo, were elected to the board of the United States Telephone Company, succeeding H. R. Newcomb, Calvary Morris and C. A. Otis. James S. Brailey, Jr., continues as president of both companies. W. L. Cary, Jr., was elected secretary of the United States company, succeeding James B. Hoge, who was made a vice-president. Mr. Cary will act as secretary for all of the Brailey properties in northern and central Ohio.

## ELECTRIC RAILWAYS.

VIRGINIA, MINN.—The city council has awarded a street railway franchise to the Mesaba Traction Company.

EAST SYRACUSE, N. Y.—The village board of trustees has granted a franchise to the Syracuse & Chittenango Railroad Company.

FAIRMONT, W. VA.—A trolley line is to be built between Fairmont and Mannington, W. Va., the preliminary arrangements having been made.

ROME, N. Y.—The Rome City Street Railway Company held a meeting on June 22 at which it was voted to increase the capital stock from $150,000 to $500,000.

BRADFORD, N. Y.—The contract for the construction of the new trolley line between Bradford and Carrolton has been let to James A. Hart & Company, of New York.

PHELPS, N. Y.—A corps of surveyors has begun work on a survey for a branch from the main line of the Geneva, Phelps & Newark electric line to Clifton Springs.

PEORIA, ILL.—Arrangements are being made by the Illinois Traction Company for large car barns which will be built in the near future to accommodate the company's property at this point.

NORWALK, OHIO—The city council has passed an ordinance granting a twenty-five-year franchise to the trustees of the proposed Cleveland & Indianapolis Railway Company to operate cars within this city.

CARMICHAELS, PA.—Council has granted a franchise to the Masontown, Smithfield & Brownsville Street Railway Company. The road will be built from Masontown to Carmichaels, thence to Waynesburg.

WARSAW, IND.—A deal has been closed whereby the United States Express Company will operate over the Winona Interurban Railway between Warsaw and Goshen, touching five cities and eight railway systems.

MACON, GA.—The Interurban Construction Company is arranging to begin work on the construction of electric lines from Macon to Griffin and Atlanta, and from Macon to Americus and Albany, about the middle of July.

ABILENE, TEX.—Work has been commenced on the street railway line of this city and will be pushed rapidly to completion. The first shipment of ties is expected soon and the road will be put in operation about October 1.

CANANDAIGUA, N. Y.—It has been stated by Edwin H. Hamlin, attorney for the Canandaigua-Southern electric road which is to connect Canandaigua with Atlanta, Steuben county, that work on the road will be commenced on September 1.

HARRISBURG, PA.—At the meeting of directors of the Chambersburg & Southern Railroad, which proposes building a trolley line from Chambersburg to Greencastle and thence to Mercersburg, it was decided to apply for a charter.

SHEBOYGAN, WIS.—Formal announcement of the consolidation of the Sheboygan Light, Power and Railway Company and the Milwaukee Northern Railroad Company is made by General Manager Gonzenbach, who will be manager of both systems.

MONROVIA, CAL.—At a meeting of the city council a franchise granting to the Pacific Electric Railroad permission to haul freight over the streets of Monrovia was allowed, the franchise to take effect after the population of the city has reached 5,000.

DAYTON, OHIO—The Dayton Street Railway Company, which proposes a line between Calvary cemetery and Catalpa drive north of the city, has been granted an extension of time until December 30 next, in which to begin the building of its road, by the county commissioners.

HARRISBURG, PA.—A charter has been granted at the state department to the Brownsville, Masontown & Smithfield Street Bridge Railway Company to construct a three-and-one-half-mile line in Westmoreland county, starting at Masontown. The company is capitalized at $20,000.

NEWBERRY, S. C.—H. L. Parr and those associated with him in the street-car system for Newberry, a charter for which was secured from the city some weeks ago, have made arrangements with Lockwood, Green & Company for a survey of the streets of the city with a view of commencing work.

PADUCAH, KY.—F. N. Whitesides, of Franklin, Ind., and L. B. Whitesides, of Chicago, chief promoters of the Ohio River Interurban road, a proposed electric line between Paducah and Cairo, are to put the deal through and start work on the road. The project was dropped two years ago, but new capital has been interested.

INDIANAPOLIS, IND.—Announcement is made that the Indianapolis, Newcastle & Toledo Traction Company will begin operating cars between here and Newcastle September 15. Most of the road between the two points has been completed. The company hopes to have its line completed to Muncie by the first of the year.

ALBANY, N. Y.—A certificate of necessity has been issued by the state railroad commissioners, authorizing the Sea Shore Municipal Railroad Company to begin the construction of its proposed street railroad five miles long, from Hempstead through Rockville Centre to East Rockaway. The capital stock of the company is $150,000.

ALBANY, N. Y.—The state board of railroad commissioners has authorized the Hornell, Bath & Lake Keuka Railway Company to build an electric street road from Hornell through Bath and Hammondsport, Steuben county, to Branchport, Yates county, a distance of about fifty miles. The company has a capital of $1,000,000.

ST. LOUIS, MO.—Congressman M. B. McKinley, president of the Illinois traction system, says his company intends effecting an agreement by January 1 next with the Indiana interurban electric system, for a through route from St. Louis to Port Huron, Detroit, Toledo, Cleveland and Erie, Pa. He says that electric trains from St. Louis to Chicago will be in operation early next year.

SPRINGFIELD, ILL.—The stockholders of the Sangamon Valley Traction Company at a meeting in Hillsboro elected L. V. Hall, state's attorney of the county, as manager of the concern, and John B. Chalcomb as trustee of the mortgage and property of the association. It is the object of the company to build north from Hillsboro immediately and connect with the Rochester-Clear Lake interurban.

ALBANY, N. Y.—At the annual meeting of the stockholders of the United Traction Company directors were chosen for the ensuing year. The only change made was the election of W. H. Williams, of New York, in the place of J. W. Burdick, resigned. The other directors are as follows: L. F. Loree, C. S. Sims, L. E. Carr, T. B. Dixey, Axel Ekstrom, C. V. Burns, J. F. McElroy and Edgar S. Fassett.

ALBANY, N. Y.—The state railroad commission has granted the Suffolk Traction Company authority to build a street surface railroad in Suffolk county to be twenty-seven miles long, with termini at the point where Beaver Dam creek intersects the south country road in the town of Brookhaven and the intersection of Deer Park avenue with the south country road, or Main street, in the village of Babylon. The capital stock is $1,200,000.

SEATTLE, WASH.—A. P. Cahill, of Dayton, Wash., one of the directors of the Columbia & Walla Walla Traction Company, which is financing the building of an electric line from Wallula to Lewiston, Mont., states that the company has the right of way for the line secured from Wallula to Dayton, and that work on this part of the road will begin this year. The matter of securing the right of way from Dayton to Lewiston will be taken up as soon as possible.

EASTON, PA.—The board of directors of the Lehigh Valley Transit Company has decided to proceed with the building of the proposed bridge to connect Allentown and South Allentown. The bridge will be 1,820 feet long and will span a ravine 115 feet deep, through which the trolley cars to Philadelphia must now work their way. The project means an expenditure of $350,000 and will be financed by E. B. Smith & Company, of Philadelphia.

NORWICH, CT.—Plans for the centralization of a power-generating plant are being made by the Consolidated Street Railway

Company, which will affect eastern Connecticut, western Rhode Island and southern Massachusetts. It is provided in the plant to ultimately have the power for street railways controlled by the corporation in this part of New England generated in Norwich. All of the company's lines hereabout will be connected so as to enable one plant to drive cars on all.

ALBANY, N. Y.—The state board of railroad commissioners has consented to the issuance by the Ithaca Street Railway Company of a mortgage for $750,000. The purposes of the mortgage are for the purchasing of the Ithaca & Cayuga Heights Railway Company and the Cayuga Lake Electric Railroad Company, to pay for current liabilities, to place additional tracks on State and Tioga streets, to add additional equipment so as to give proper service and to replace the greater part of the present track with heavier rails. It is also proposed to provide for interurban traffic and to provide a suitable power station.

MEMPHIS, TENN.—The stockholders of the Kentucky & Ohio River Interurban Railway, projected from Paducah to Cairo, have made necessary arrangements for financing the construction of this road. The right of way for the line was secured several years ago, but construction was held in abeyance pending the necessary financial arrangements. The road will pass through the richest section of McCracken and Ballard counties. At East Cairo passengers will be transferred to the ferry for Cairo. Connection will be made with all trains at both Paducah and Cairo. The road will handle both freight and passenger traffic. The company is backed by a number of eastern capitalists as well as business men of Paducah and Cairo.

PHELPS, N. Y.—It is reported that the original company known as the Geneva, Phelps & Newark Electric Road Company, which applied to the town officials about a year ago for a franchise to construct an electric road, and which application was granted with the understanding that the road was to be in operation within two years, has sold the franchise to the J. G. White Construction Company, now engaged in building the Rochester, Eastern & Syracuse road. It is also said that a spur will be built from here to Clifton Springs. It is further stated that work will be commenced on the line from Geneva *via* Phelps to Newark as soon as the White Construction Company completes the Rochester, Syracuse & Eastern as far as Clyde. In order to retain the franchise through this village, this will have to be done as the franchise expires within a year.

HARTFORD, CT.—The Milford Investment Company, of New Haven, has filed a certificate of incorporation with the state secretary. The authorized capital stock is $2,750, all paid in. The corporation proposes "to provide for the funding of the floating debt of the Milford & Uxbridge Railroad Company by the stockholders of said company in such a way that it may be provided for, and for such purpose to issue bonds of this company to an amount not exceeding $250,000, and to loan the proceeds of said bonds to said railway company and to acquire and hold the notes, obligations or other indebtedness of said railway company and to renew the same from time to time, as may be necessary, and provide for the collection and payment of the same." Joel A. Sperry, George F. Holcomb and Talcott H. Russell, all of New Haven, are the incorporators.

ALBANY, N. Y.—The state board of railroad commissioners has granted a certificate of necessity to the Hornell, Bath & Lake Keuka Railway Company. The company proposes to build an electric street surface railroad from Hornell, through Bath and Hammondsport, in Steuben county, to Branchport, in Yates county. The capital stock of the company is $1,000,000; length of the road about fifty miles. The board has approved of an increase of the capital stock of the Utica & Mohawk Valley Railway Company from $6,250,000 to $7,500,000. The money will be used to provide additional finances for the work which that company has under way. The board has consented to the issuance by the Poughkeepsie City & Wappinger's Falls Electric Railway Company of a mortgage for $250,000. The money will be used to provide new cars, equipment, etc., to replace that destroyed by fire and in satisfaction of lawful debts of the company. The Hornell, Bath & Lake Keuka Railway Company has applied to the state board of railroad commissioners for consent to the issuance of a first mortgage for $2,000,000.

## ELECTRICAL SECURITIES.

Last week there appeared to be a general rally, both in sentiment and in fact, and prices show a consequent improvement. The favoring weather conditions here and the prediction that foreign crop conditions will mean a shortage abroad indicate that the agricultural community of this country will continue to be a dominant influence with regard to the wealth of the land. The failure of the New York city bond sale shows that investors are either very cautious or are holding out for better rates, and opinion is mixed concerning the permanent effect the results of this sale will have on investments in general. Railroad earnings, after losses earlier in the year, are showing both gross and net gains over record earnings of last year, and the ordinary financial and industrial barometers give signs of fair weather and clear sailing, with the murkiness occasioned by recent foreign disturbances, notably the French wine riots, dissipating under a natural pressure of law and order and a disposition on the part of the people of the world to dispassionately wait for conditions beyond their immediate understanding to work themselves out under the guidance of the master minds which they have elected to think and do for them in administrative departments of government.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JUNE 29.

| *New York:* | *Closing.* |
|---|---|
| Allis-Chalmers common | 10⅜ |
| Allis-Chalmers preferred | 29¼ |
| Brooklyn Rapid Transit | 55¾ |
| Consolidated Gas | 119 |
| General Electric | 139 |
| Interborough-Metropolitan common | 15¾ |
| Interborough-Metropolitan preferred | 43⅞ |
| Kings County Electric | 122 |
| Mackay Companies (Postal Telegraph and Cables) common | 67 |
| Mackay Companies (Postal Telegraph and Cables) preferred | 65½ |
| Manhattan Elevated | 131 |
| Metropolitan Street Railway | 85 |
| New York & New Jersey Telephone | 112 |
| Western Union | 79 |
| Westinghouse Manufacturing Company (ex-dividend) | 145 |

The New York & New Jersey Telephone Company has declared the regular quarterly dividend of 1¾ per cent, payable on July 15 to stockholders of record on July 5.

A representative of the Westinghouse Electric and Manufacturing Company says the business of the company in June will correspond very closely with the volume of new orders received in the preceding month. The orders for May ran very close to $4,000,000 in valuation, and there has been no let up in this respect since the first of the year For the year ended March 31, last, the orders of the Westinghouse Electric and Manufacturing Company aggregated $34,170,649. Orders since the first of the year have been running at the rate of about $45,000,000 a year.

| *Boston:* | *Closing.* |
|---|---|
| American Telephone and Telegraph | 108¾ |
| Edison Electric Illuminating | 205 |
| Massachusetts Electric | 58 |
| New England Telephone | 110 |
| Western Telephone and Telegraph preferred | 70 |

Directors of the Edison Company of Boston have declared the regular quarterly dividend of 2½ per cent and 1 per cent extra. The dividends are payable August 1 to stockholders of record July 15.

| *Philadelphia:* | *Closing.* |
|---|---|
| Electric Company of America | 9¾ |
| Electric Storage Battery common | 50 |
| Electric Storage Battery preferred | 50 |
| Philadelphia Electric | 8⅛ |
| Philadelphia Rapid Transit | 24 |
| United Gas Improvement (ex-dividend) | 92½ |
| *Chicago:* | *Closing.* |
| Chicago Telephone | 125 |
| Chicago Edison Light | 142 |
| Metropolitan Elevated preferred | 63 |
| National Carbon common | 71 |
| National Carbon preferred | 110 |
| Union Traction common | — |
| Union Traction preferred | — |

Directors of the National Carbon Company have declared the regular quarterly dividend of 1 per cent on the common stock payable July 15. Books closed July 5 and will reopen July 16.

## PERSONAL MENTION.

MR. W. E. DOOLITTLE, president of the Sterling Electric Company, Lafayette, Ind., was a Chicago visitor last week.

MR. H. L. WELLS, manager publicity department, Power and Mining Machinery Company, Milwaukee, Wis., was a visitor in Chicago for the week ending June 29.

MR. HENRY G. BRADLEE has become a partner in the firm of Stone & Webster, of Boston, Mass. The other members of the firm are Charles A. Stone, Edwin S. Webster and Russell Robb.

MR. WILLIAM L. DERR, one time superintendent of the Hartford division of the New York, New Haven & Hartford, and later with the Chicago & Alton, has been appointed general superintendent of the New York City Railway.

MR. HENRY J. BLAKESLEE, of Utica, N. Y., has been appointed superintendent of the new bureau of gas and electricity for Syracuse, N. Y., created by the Hammond law regulating that branch of the public commercial service, to take effect July 15.

MR. G. E. PECK, formerly with the Waterloo, Cedar Falls & Northern Interurban at Waterloo, Iowa, has accepted the position of auditor and cashier of the Mason City & Clear Lake Interurban and the People's Gas and Electric Company, Mason City, Iowa.

MR. J. F. SHIPP, who has been connected with the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, for the past two years, has been promoted to the position of assistant manager of the electrical department of the Milwaukee branch of that company.

MR. P. L. GALLAGHER, superintendent of the St. Lawrence International Electric Railroad and Land Company, Alexandria Bay, N. Y., has resigned, and is succeeded by Henry F. Sweeney, of Watertown. Mr. Sweeney has been chief electrician of the road. A. E. Rea, chief engineer of the road, has also resigned.

MR. WILLIAM BROYLES has resigned as manager of the Palestine (Tex.) Electric Light Company. He is succeeded by J. R. Cox, of Galveston, Tex., who for the past eleven years has been manager of the Brush Electric Light and Power Company, of that city. P. Bauer, superintendent of the Palestine company, has also resigned.

MR. JOHN J. GHEGAN, president of J. H. Bunnell & Company, was a recent visitor to Atlantic City, N. J., accompanied by Mrs. Ghegan and the family. Mr. Ghegan was kept busy renewing old acquaintances among the members of the telegraph fraternity in attendance at the meeting of the Association of Railway Telegraph Superintendents.

MR. A. F. BROWN has been appointed manager of the New York office of the Central Telephone and Electric Company, St. Louis, Mo. Mr. Brown already represents the Tower-Binford Electric Company, the W. J. Barr Electric Manufacturing Company and the Rock Island Dry Battery Company. His headquarters are at 120 Liberty street, New York city.

MR. W. E. TERRY, secretary and treasurer of the Meridian Light and Railway Company, Meridian, Miss., has tendered his resignation to take effect July 15. He will go to Savannah, Ga., to accept a similar position. Mr. Terry has been in the employ of the Meridian Light and Railway Company since February 15, 1905. He began service in the lower ranks, but was quickly advanced.

MR. B. S. JOSSELYN has resigned as vice-president of the Baltimore Electric and Maryland Telephone Companies, to become president of the Portland (Ore.) Railway, Light and Power Company. This company is controlled by E. W. Clark & Company, of Philadelphia, J. W. Seligman and Pratt & Company, of New York. It owns all the street railway lines and electric plants in Portland.

JOHN J. MAGILTON has recently associated himself with J. G. White & Company, of New York city, having resigned as assistant to the president of the Hudson River Electric Power Company, of Albany, N. Y. Mr. Magilton has in the past been general auditor of the Schenectady Railway Company, Schenectady Illuminating Company, and the Mohawk Gas Company, of Schenectady, N. Y. He has also been an executive officer of the Street Railway Accountants' Association of America.

MR. GEORGE F. ADAMS and MR. JAMES R. BROWN, who have been connected with the Westinghouse Electric and Manufacturing Company for the past ten years, have resigned from the Cleveland selling organization and have opened an office in the New England Building, Cleveland, Ohio, under the style of Adams & Downs. They have an agreement with the Burke Electric Company as selling representatives to handle the complete line of alternating and direct-current dynamos and motors manufactured by the Burke Electric Company.

## INDUSTRIAL ITEMS.

WILLIAM A. BONNELL, 132 Church street, New York city, is calling attention to the Bonnell conduit and cable couplings with a neat advertising blotter.

THE CONDIT ELECTRICAL MANUFACTURING COMPANY, Boston, Mass., will be pleased to send its bulletin describing Condit circuit-breakers upon request.

THE H. B. CAMP COMPANY, Flatiron Building, New York city, is mailing an attractive folder illustrating a street in Belgium, where a large installation of Camp conduits is being made.

THE WORCESTER ELECTRIC MANUFACTURING COMPANY, 42 Lagrange street, Worcester, Mass., has ready for distribution a new catalogue describing and illustrating Worcester National Electrical Code Standard knife switches, fuse blocks and switchboards.

HARVEY HUBBELL, INCORPORATED, Bridgeport, Ct., has issued a neat booklet, entitled "Portable Electricity," calling attention to the Hubbell appliances. A feature of the Hubbell line of attachment devices is their interchangeability, but one size of cap being used on the entire line.

ARTHUR W. FOX, 83 Schermerhorn street, Brooklyn, N. Y., has placed on the market a drawing-ink holder made of nickel-plated steel, consisting of a shallow cup having four spring clips so designed as to hold the bottle. The cup is held to the drafting table or any other convenient place by means of an ordinary thumb tack.

THE DETROIT & BUFFALO STEAMBOAT COMPANY, Detroit, Mich., announces complete service between Detroit and Buffalo. A trip on the palatial steamers, Eastern States and Western States, makes up a most delightful holiday. Staterooms and parlors are reserved in advance. A two-cent stamp should be sent to L. G. Lewis, general passenger agent, for illustrated booklet.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., in order to handle the mass of business in electric generators and motors in southern Ohio, has found it advisable to open a suboffice in the Columbus Savings and Trust Company Building, Columbus, Ohio. This office is supplementary to the Cleveland office, and will be in charge of Charles W. Cross, formerly of the Cleveland office.

PASS & SEYMOUR, INCORPORATED, Solvay, N. Y., announces that it has taken over the business of the Sarco Company, 906 Sixth avenue, New York city, and will hereafter manufacture the Sarco Company's specialties, consisting of attachment plugs, pendant switches, key-arm switches, push-buttons, etc. All orders and inquiries for this material should be addressed to Pass & Seymour, Incorporated, Solvay, N. Y.

THE GENERAL ELECTRIC COMPANY, Schenectady, N. Y., has ready for distribution bulletins Nos. 4506 and 4516, devoted respectively to the Edison Gem filament, fifty-watt lamp, and MR circuit-breakers, and a supplement to bulletin No. 4495, devoted to General Electric direct-current fan motors, type DL. The company also has ready for distribution a new series of advertising literature devoted to the following subjects: bulletin No. 4509, electric train lighting; bulletin No. 4514, Thomson inclined coil portable indicating instruments, types P and P-2; bulletin 4515, auxiliary contactor equipments for cylinder controllers.

THE OHIO BRASS COMPANY, Mansfield, Ohio, has published a handsome and elaborate catalogue (No. 7) devoted to electric railway and mine supplies. The catalogue contains 584 pages, is well bound in cloth covers, six and one-quarter by nine and one-quarter inches, and the cover illumination is in goldleaf. Supplementing

the illustration of the material, is complete descriptive text, code word, number, and list prices. Some engineering data is added, and the index to materials, index to trade numbers and index to code words are very complete.

THE BLAKE SIGNAL AND MANUFACTURING COMPANY, 246 Summer street, Boston, Mass., announces that its tube flux is meeting with considerable favor among all classes of consumers. Some recent orders have come from the following: Union Switch and Signal Company, Pennsylvania Steel Company, Long Island Railroad Company, Boston & Maine Railroad Company, Newport & Fairbridge Railway Company, Kny-Scheerer Company, Johns-Pratt Company, Electro-Dynamic Company and the Emerson Electric Manufacturing Company.

THE ELMER P. MORRIS COMPANY, New York city, in catalogue No. 16, illustrates and describes an elaborate line of ornamental poles for electric railways and electric lighting systems. These poles are shown with arc lamps, incandescent lamps and reflectors, windlasses and sockets. The company manufactures wrought-iron and steel plain and ornamental tubular poles and pole brackets, high-tension pins, brackets and break-arms, and a complete line of material used in the construction and operation of electric railways and high-tension lines. The factories are located at Cincinnati, Ohio; Reading, Pa., and Walton, N. Y.

THE WIRE AND TELEPHONE COMPANY OF AMERICA, Rome, N. Y., announces that its new wire-drawing mills, which have been under course of construction to replace those destroyed by fire in February, are now practically completed. Machinery is now being installed and will be operating early in July. As a result of the fire loss of this company it has taken advantage of the opportunity of installing the latest and most improved machinery, and has spared no expense to secure what will undoubtedly be one of the best equipped and most modern wire-drawing plants in this country. During the interval since the fire it has not ceased operations in its manufacturing plant devoted to the manufacture of magnet wire, rubber-covered wire and telephones, having had its copper drawn for it by other mills to take care of its own requirements and those of its customers.

THE WESTERN WIRE SALES COMPANY, 24 Dearborn street, Chicago, Ill., has been made general western agent for the Bay State Insulated Wire and Cable Company, Hyde Park, Mass. This company has been organized quite recently, and has at its head Andrew J. Conlin, for the past seventeen years associated with the Simplex Electrical Company. J. H. McNamee, treasurer and general manager of the new company, is well known throughout New England, and was at one time mayor of Cambridge, Mass. Outside of the regular lines of rubber and lead-covered insulated wires and cables, the company is making a specialty of railroad signal wire to meet any specification, thirty per cent pure Para rubber insulated wires and cables, mining cables, flame-proof wires, telephone wires, etc. The Western Wire Sales Company publishes a monthly bulletin entitled, "The Wire Market News." This bulletin contains interesting articles concerning copper and the copper situation.

# Record of Electrical Patents.

**Week of June 25.**

857,569. ELECTRIC CURLING-IRON. Isabell Allen, Kansas City, Mo., and George Hanlon, Shawneetown, Ill. An electric curling-iron with a current-controlling means in the handle.

857,591. TROLLEY HARP. Arlington D. Brittain, Youngstown, Ohio. A combination of a trolley and harp, the wheel section of the trolley having an inwardly extending flange.

857,606. BATTERY. Frank A. Decker, Philadelphia, Pa., assignor, by mesne assignments, to Decker Electrical Manufacturing Company, Wilmington, Del. A storage battery having imperforate walls of porous material.

857,607. ELECTROCHEMICAL APPARATUS. Frank A. Decker, Philadelphia, Pa., assignor, by mesne assignments, to Decker Electrical Manufacturing Company, Wilmington, Del. The contact with electrodes is made through the end walls of the respective electrode compartments.

857,612. TROLLEY STAND. Edgar L. Fixler, Delta, Ohio. A trolley stand having a yieldingly mounted socket part and a spring-pressed key pivoted to and overlapping the movable socket part.

857,621. SWITCHING DEVICE. Alexander M. Haubrich, Chicago, Ill., assignor to Stromberg-Carlson Telephone Manufacturing Company, Rochester, N. Y. A combination operator's ringing and listening key.

857,643. TROLLEY GUARD. George L. Matheney, Bridgeport, Ohio, assignor of one-half to J. O. Howells, Bridgeport, Ohio. A combination of a trolley wheel and trolley guard.

857,664. ELECTROMEDICAL APPLIANCE. David R. Overman, St. Louis, Mo. A pad containing an electro-galvanic battery for application to the person.

857,686. ELECTRICALLY PROPELLED VEHICLE. Russell Thayer, Philadelphia, Pa. A vehicle deriving current alternately from an external supply system and from a storage battery.

857,708. CIRCUIT-OPERATING DEVICE. Leonidas G. Woolley, Lima, Ohio, assignor to John C. Riley, Lima, Ohio. A combination of a magneto and a toothed signal wheel.

857,729. ELECTRIC BRAKE. Emil Franke, Astoria, N. Y. A combination of a cylinder and electromagnets carrying telescoping armatures.

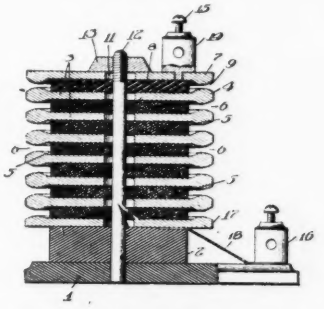
857,735. FUSED PLUG AND RECEPTACLE. John C. Hatzel and Edgar L. Morley, New York, N. Y. A switchboard receptacle comprising a tubular casing, a contact spring, and means for securing the casing to the switchboard connection.

857,787. OSCILLATING DEVICE FOR MOTOR-DRIVEN FANS. Herbert S. Brown, New York, N. Y. An oscillating device located in the motor fan support.

857,792. RAILROAD BRAKE. Howard A. Coleman, Sanborn, Iowa. A movable brake-bar provided with brake-shoes normally held at the applied position, and electromagnets which apply the brakes.

857,797. MOTOR-CONTROL APPARATUS. George W. Euker, Pittsfield, Mass., assignor to Stanley-G. I. Electric Manufacturing Company. A motor-starting rheostat tending normally to assume its off position.

857,849. LIGHTNING ARRESTER. Joseph V. E. Titus, Keokuk, Iowa, assignor to Electric Service Supplies Company, Philadelphia, Pa. A lightning arrester comprising a plurality of plates with layers of resistance material interposed.



857,849.—LIGHTNING ARRESTER.

857,857. INDICATOR. William A. Banister and David M. Lake, Newark, N. J. An advertising indicator.

857,866. INDUCTION COIL. Morris W. Brinkmann, New York, N. Y. An induction coil provided with interrupters for controlling a predetermined current strength.

857,880. PRIMARY BATTERY. Charles E. Hite, Philadelphia, Pa., assignor to Hite Electric Company. A primary battery made up of a plurality of primary cells, the bottoms of which open into a common electrolyte.

857,886. METHOD OF LINING TANKS FOR ELECTROLYTIC WORK. John F. Miller, Trail, British Columbia, Canada. A process of making an insulating joint.

857,909. ELECTROLYTIC CELL. Alfred O. Tate, New York, N. Y. An electrode for an electrolytic cell for multiple connection to the terminals.

857,910. APPARATUS FOR TREATING LIQUIDS ELECTROLYTICALLY. Alfred O. Tate, New York, N. Y. An electrode for an electrolytic cell, embracing alternate sets of conductors, one set constituting a multiple anode, and the other a multiple cathode.

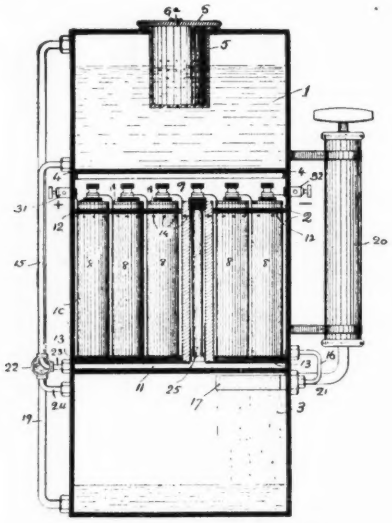
857,928. FITTING FOR ELECTRIC LAMPS. John Dugdill, Failsworth, near Manchester, England. A knuckle joint for an electric-light fitting.

857,929. STORAGE-BATTERY ELECTRODE. Thomas A. Edison, Llewellyn Park, Orange, N. J., assignor to Edison Storage Battery Company, West Orange, N. J. An electrode mass comprising an intimate mixture of active material and metallic flakes formed wholly or in part of metallic cobalt.

857,953. ALTERNATING-CURRENT MACHINE. Ralph D. Mershon, New York, N. Y. An alternating-current machine adapted to vary the number of its poles.

857,959. AUTOMATIC TELEPHONE EXCHANGE. Nils E. Norstrom, Junction City, Kan., assignor of one-half to John Anderson, Salina, Kan., and one-sixth to M. E. Richardson, Sterling, Kan. A switch mechanism operated according to the direction of the current impulse.

857,966. AUTOMATIC TELEPHONE SWITCH. Charles M. Thompson, Chicago, Ill., assignor to Charles M. Thompson Company, Chicago, Ill. A step-by-step switch system controlled by opposing windings.



857,880.—PRIMARY BATTERY.

858,002. SPEED-GOVERNOR FOR DYNAMOS. Edward B. Jacobson, Pittsfield, Mass., assignor to Pittsfield Spark Coil Company, Pittsfield, Mass. An electromagnet varying the position of a dynamo in accordance with the intensity of the current generated.

858,011. METER. William J. Mowbray, New York, N. Y. A motor comprising a plurality of coil sections arranged at progressively increasing distances from the armature.

858,016. ARMATURE-TESTING APPARATUS. Victor Patton, Hastings, Col. A test circuit with means for cutting one or more windings into said circuit.

858,064. SIGNAL. Harold W. Eden, Detroit, Mich., assignor to P. R. Manufacturing Company, Detroit, Mich. A dust-proof signal bell.

858,097. DYNAMOELECTRIC MACHINE. Bradley T. McCormick, Cincinnati, Ohio, assignor to the Bullock Electric Manufacturing Company. A series winding is connected in multiple series, all the connectors being on the same side of the machine.

858,117. MEDICAL BATTERY. Charles W. Taylor, New York, N. Y. A self-contained medical battery.

858,120. SIGNALING SYSTEM FOR ALTERNATING CURRENTS. Louis H. Thullen, Edgewood Park, Pa., assignor to the Union Switch and Signal Company, Swissvale, Pa. A track bond composed of magnetic and non-magnetic materials.

858,135. ELECTRIC TANK SWITCH. Jacob T. Anderson, New York, N. Y. An oscillating float tank switch.

858,160. ANODE. Alexander J. Deloye, Torrington, Ct. An anode comprising a body of constantly changing cross-section.

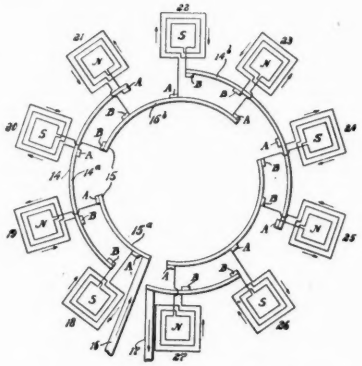
858,196. APPARATUS FOR PRODUCING ELECTRIC SPARKS. William Marshall, New York, N. Y., assignor of one-fourth to John A. Bullinger, New York, N. Y. An electric oscillator.

858,211. ELECTROMAGNETIC LOCOMOTIVE. Joseph L. Potter, Indianapolis, Ind., assignor to Harry G. Hawekotte, Indianapolis, Ind. An electromagnet and flywheel give a reciprocating motion.

858,216. TELEGRAPH REPEATER. Worth Rogers, St. Louis, Mo. A method of preserving the continuity of the main line through a repeating station.

858,222. ELECTRIC CURRENT CONTROLLER. Max Schuppe, New York, N. Y., assignor to Bernard F. Seadler, New York, N. Y. Means for making predetermined motor or dynamo connections.

858,238. TROLLEY FINDER. Frederick G. Weber, Ashland, Ky. A combination of a trolley wheel and guide bracket.



858,097.—DYNAMOELECTRIC MACHINE.

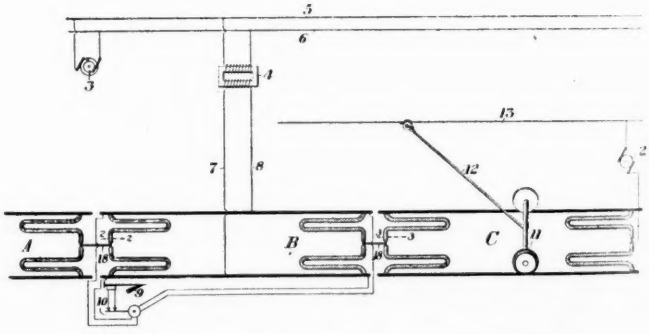
858,246. DIRECT-CURRENT DYNAMOELECTRIC MACHINE. Edwin C. Wright, Newport, Ky., assignor to Allis-Chalmers Company, and the Bullock Electric Manufacturing Company. The commutator leads serve as band wires to retain a commutating ring in position.

858,255. TROLLEY FOR ELECTRIC RAILWAYS. Harry Bennett, Newark, N. J., assignor to the Bennett Inventing and Manufacturing Company. A tubular pole containing the trolley-harp tension spring.

858,288. BRANCH BOX. Albert F. Hills, Syracuse, N. Y., assignor to Crouse-Hinds Company, Syracuse, N. Y. A metallic combination branch box.

858,335. APPARATUS FOR MEASURING ELECTRICAL RESISTANCE. Sydney Evershed, Chiswick, England, assignor to himself, and Evershed and Vignoles Limited, Chiswick, England. A combination of Wheatstone bridge and magneto ohmmeter.

858,341. APPARATUS FOR ELECTROLYTIC DEPOSITION OF METALS. Herbert C. Harrison, London, and Joseph Day, Weston-super-Mare, England; said Day assignor to said Harrison. An electrolytic leaching depository.



858,120.—SIGNALING SYSTEM FOR ALTERNATING CURRENTS.

858,351. INSTANTANEOUS ELECTRIC WATER HEATER. Herbert N. Roche and Fred F. Breese, San Francisco, Cal., assignors of one-half to the James W. Edwards Company, one-fourth to said Herbert N. Roche, and one-fourth to Thomas B. Gray, San Francisco, Cal. A plurality of heating tubes arranged on a lining of insulating material.

858,355. TROLLEY CATCHER. Robert Shields, South Boston, Mass., assignor to Frank Ridlon Company, Boston, Mass. A rotating reel with its pawl and stop is located in a suitable supporting case.